

SIXTY-NINTH YEAR

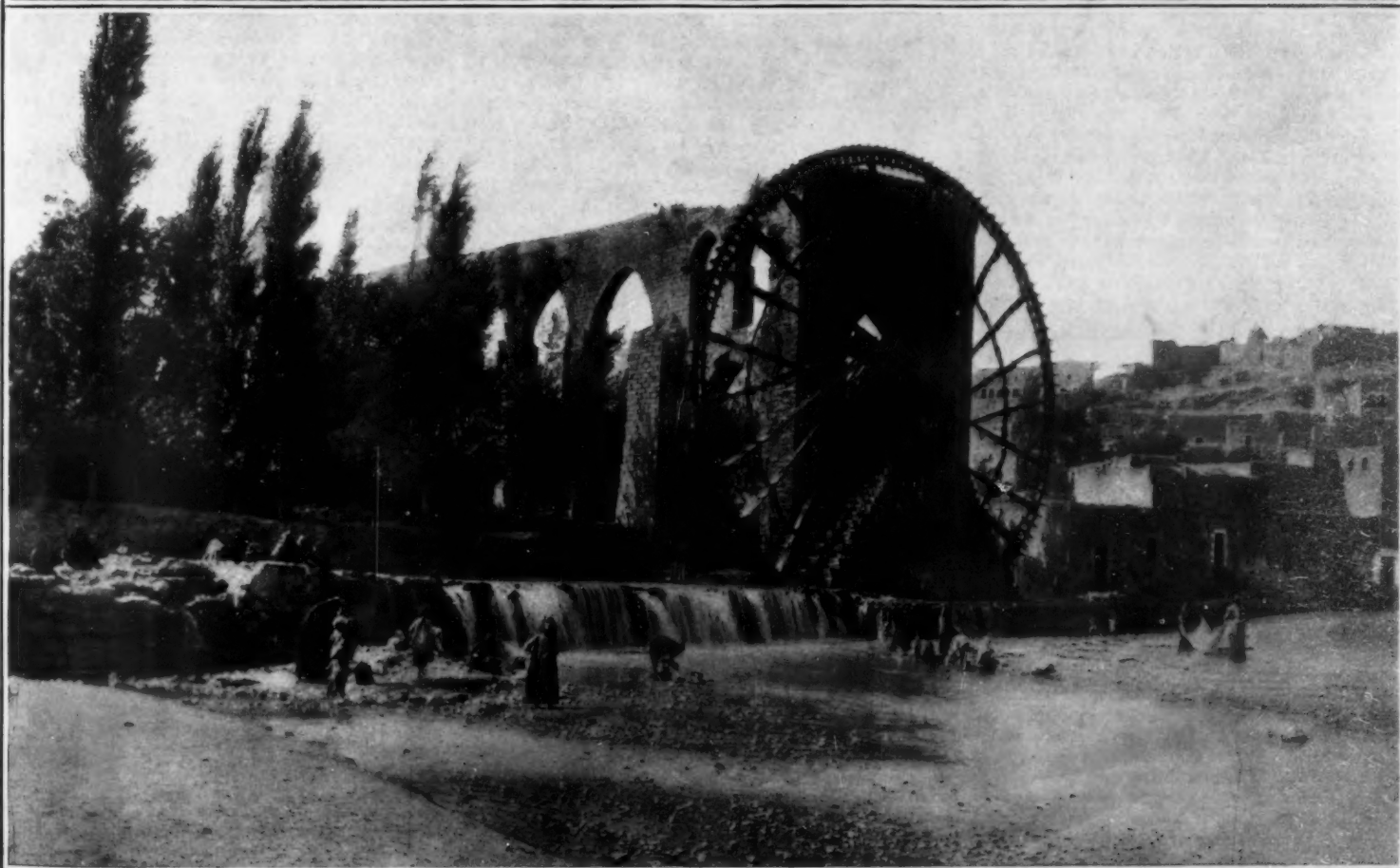
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In northern Syria, on the banks of the river Orontes, are four waterwheels, each bearing a name of its own. They are used for pumping up the water of the river for irrigation.

THE UNDERSHOT WATERWHEELS OF NORTHERN SYRIA.—[See page 172.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Standard for Safe Railroad Travel

THAT the risks of railroad travel in the United States are beyond all reason is admitted. The question of the safety of the American railroad passenger is a relative one—to be determined by some accepted standard. For such a standard let us go back to the British Board of Trade's statistics of accidents in the United Kingdom for the year 1908, when out of one billion, five hundred million passengers carried, not one was killed. In that same year our Interstate Commerce Commission reported that out of less than a billion passengers carried, the number killed in train accidents was 165.

But we do not have to go outside of New York city for a standard of safe travel that exceeds even the British record—always bearing in mind the density of the traffic. The New York subway during the eight years of its operation has carried 1,664,516,822 passengers without a single fatality due to train accident. What makes the record so astonishing is the fact that about 70 per cent of these people were carried on express trains, running at from 40 to 50 miles per hour and under the unprecedented headway (for the past few years) of 1 minute and 43 seconds. This feat, which, in view of the high speed and short headway, has never been approached, has been accomplished under shelter, it is true, and free from the hazards of the weather; but it sets a standard which is not impossible of accomplishment, surely, under the vastly greater headway of a trunk steam railway. The subway record is mainly due to excellent block signals and the automatic stop. Both of these should be made compulsory on steam roads.

We are well aware that the question of safety is largely one of discipline; but the subway officials assure us that the automatic stop conduces to discipline, for the reason that every operation of the stop constitutes a record against the man who passes a signal.

Comparative Cost of Direct and Single Phase Electrification of Steam Railroads

IN the absence of any definite figures as to the relative costs of the New York Central direct-current and the New Haven single-phase installation, great value attaches to the report on the tenders which have been submitted by the leading electrical manufacturers of the world, for the electrification of the extensive system of suburban railways of the city of Melbourne, Australia. The city railways enjoy a practical monopoly of suburban traffic, and although the service rendered by steam locomotives has always been excellent, the growth of traffic has been so great that the city has turned to electric traction as the only solution of the problem.

The present traffic on the roads affected is about ninety million passengers per year, and it is estimated that in 1917, after electrification, the total will have reached one hundred and fifty millions per year.

Before deciding on the system to be employed the Government and the Railway Commissioners decided to have complete alternative schemes prepared, one on the direct and the other on the alternating-current system. Specifications were drawn up and tenders were invited, in response to which offers were received from the leading manufacturers of the world, who prepared complete proposals accompanied by stringent guarantees. Before inviting tenders, special pains were taken to see that the rival schemes were comparable and fair

to the makers of the different systems. Since no serious criticism has been put forward by the exponents of either system, it is reasonable to assume that they were fair to all the parties concerned. The suburban lines comprise some one hundred and fifty miles, and the cost of converting these lines on the direct-current system was \$11,750,000. To convert the same lines on the single-phase system would have cost \$15,275,000. These figures, it should be explained, relate only to those items of capital expenditure which would be affected by the different systems. A comparison of the annual cost of the operation of the two systems gave the following results: Direct current, \$1,270,870; single-phase, \$1,623,700.

So that from this comparison of costs, based on the proposals of the leading manufacturers of the world for electrifying the same 150 miles of road, we find that the direct-current system shows an advantage in first cost of \$3,525,000, and in the annual cost of operation of \$352,835. It has been generally believed that, although the direct-current system shows an advantage on suburban lines where the traffic is dense, it would be found that on longer lines with a relatively scant traffic, the advantage would lie somewhat heavily with the single-phase system. In order to arrive at a just comparison, the engineer of the commissioners analyzed the relative cost of electrifying the Melbourne, Woodend and Bendigo line, which has a length of 100 miles. Even in this case it was found that the initial cost of conversion on the single-phase system would be greater by about \$65,000, and that the annual cost of operation would be greater by about \$8,000. The great importance of this comparison is realized, when it is understood that the proposed conversion will cover altogether about three hundred miles of steam railroad tracks.

Under the direct-current scheme which is to be adopted, power will be supplied as three-phase alternating current at 25 cycles per second, and a pressure of 20,000 volts. This will be transmitted, partly by underground cable, partly by overhead wires, to twelve sub-stations. There it will be transformed and converted to direct-current at 1,500 volts. The trains will consist of from two to six cars operated on the multiple-unit system. The schedule speed for the suburban service, including stops, will be 21 miles per hour.

Shall We Have Compulsory Licenses?

THOSE who are responsible for the Oldfield bill seek to justify the introduction of "compulsory licenses" into the American patent system on the ground that England and Germany have adopted the principle with success. Representative Oldfield is haunted by the fear that meritorious inventions are suppressed.

Study the history of foreign patent legislation and you will find that the English and German "working clauses" were framed not for the purpose of preventing the suppression of inventions, but solely to protect manufacturers from foreign commercial invasion.

Thus, the English patent law is intended to give British manufacturers and the British workmen an advantage over their more progressive German and American rivals, by declaring a patent forfeited if it has not been adequately worked within a stipulated period. Similarly the corresponding German laws, now all but abandoned, were intended to prevent foreigners from dominating German commerce.

If we may judge from the opinions expressed by British patent attorneys, England is awakening to the evil effect of her drastic patent laws. In a paper prepared for the Sixteenth Congress of the International Association for the protection of industrial property, held in London, in June, 1912, Oliver Murray, Fellow of the Chartered Institute of Patent Agents, and Hugh Fletcher Moulton, Barrister-at-Law, had this to say with reference to the British Compulsory License Provision:

"The passing of Section 27 has certainly introduced an additional and very serious and complicated ground on which the validity of every patent can be attacked after four years, thus rendering it far less secure as a property, destroying to some extent the monopoly of fourteen years heretofore granted to a patentee, and deterring capitalists from financing the invention and so introducing the industry into this country."

"The results obtained are infinitesimally small compared with the largest number of existing patents (100,000) even after deducting from this number those patents which may be considered of minor importance; and this, in itself, is an absolute proof of what a small call there was for this very serious and drastic alteration of the law, an alteration practically admitted by all countries from many years' actual experience to be a mistake. For this very unimportant result, a slur on or an additional ground for questioning the validity of all the remaining patents stands out as a deterrent to the investment of capital for exploiting what may be very valuable inventions. The effect of the passing of Section 27 of 1907, which we cannot help condemning as a retrograde step, has caused considerable agitation, antagonistic to British patentees in all countries of the world."

Between August 28th, 1908, and the end of June, 1912, eighty-three demands were made for the revocation of patents, because the inventions which they covered were manufactured mainly in foreign countries.

Of these eighty-three demands no less than twenty were granted. On the other hand only one demand was made for the granting of a compulsory license, and that demand was withdrawn by agreement between the parties.

The harshness of the British Act may be judged from a brief review of actually decided cases. Anyone can apply for an order, whether or not he has a real interest in developing British industries or not. It is irrelevant whether the applicant shows that the order will develop an existing industry or lead to the establishment of a new industry. Even though the sole purpose of the applicant is to import foreign made articles into the country free from the restraint of a British patent, the order must be granted. The lack of a demand in Great Britain for the article protected by the patent is not accepted as any excuse for failing to work it. If the article is made anywhere else in the world, the patent owner must set about creating a demand for it, in Great Britain. It will not suffice the patent owner to show that he has made genuine attempts to dispose of the patent, unless the Comptroller happens to agree that these efforts are all that a British business man should reasonably have made. The fact that a patent owner has done the best he could according to the standard of his own country or the country where the article originated is not enough. It will not suffice that the patent owner simply advertised that he desires to dispose of his patent, or that he sent around circulars stating that he wished to sell his patent, or intended to enter into a working arrangement to manufacture it in Great Britain. If the Comptroller finds that the advertisements, circulars, or other offers were framed vaguely, and gave no intimation of the terms on which the patent owner was prepared to treat beyond the statement that such terms would be reasonable, the order must issue. Finally the Comptroller may decide that the unlucky patent owner, besides advertising and offering his patent to British manufacturers, ought also to have given demonstrations of the invention within Great Britain.

These actual British cases are of interest because some of them could easily arise if the Oldfield bill becomes a law.

Germany's experience has not been more encouraging. Indeed, the clause in the German patent law which required the working of patents has been practically abolished. Only in case the public interest (not the selfish interest of a private manufacturer, as the Oldfield bill would have it) is at stake will the Government interfere. Thus, the discovery of a new chemical compound which would curb an epidemic might be appropriated. This slight remnant of the old practice has been retained, not because of any unshakable belief in the virtue of revocation or of compulsory license, but because the German government feels the need of a weapon in negotiating patent treaties with countries that compel the working of patents. Such is the explanation of the German attitude given by A. duBois Raymond, and Prof. Dr. Osterrieth, both distinguished authorities on German patent practice and both of whom have expressed their opinions in separate papers included in the recently issued report on the Patent Office submitted by the President's Commission on Economy and Efficiency. Both assure us that the popularity of the working clause has steadily diminished as the German people became convinced of its utter worthlessness and of the annoyance that it caused.

If the United States Government wishes to follow the German practice and reserve to itself in the public interest the right to appropriate certain inventions, there is no need of any such measure as that proposed by Representative Oldfield. Under the existing patent law the United States Government has the right to appropriate inventions upon the principle of eminent domain—a right which it has not hesitated to exercise. But the Oldfield proposal goes far beyond this feature of the German law. It seeks to establish over every kind of patents a species of eminent domain for the mere private, selfish purpose of whomsoever seeks to apply for a compulsory license.

All the testimony taken before the Congressional Committee, to whom the Oldfield bill was referred, conclusively establishes three points. First, that the existing patent laws of the United States are on the whole superior to the patent laws of Great Britain, Canada, Germany, France and any other foreign nation. Second, that from the point of view of the public, the inventor, the manufacturer, and the consumer, the provisions of the substitute Oldfield bill regarding compulsory licenses are worse than the corresponding provisions of the patent laws of Great Britain, Germany, France and other foreign nations. Third, that the experience of Great Britain, Germany, France and every other foreign nation that has tried anything resembling compulsory license, as proposed by the substitute Oldfield bill, has proved that, from the point of view of the public, the inventor, the manufacturer, and the consumer, compulsory license is a failure, and a distinct discouragement of invention.

Science

A Remarkable Photograph of a Meteor Trail is published in the *Bulletin* of the Astronomical Society of France, having been previously published in India, where the original was, on account of its unique character, awarded the first prize in a photographic competition held by the *Times of India Illustrated Weekly*. It was taken by an English sergeant, A. Hempstead, at Mhow, India. The meteor, which was very brilliant, was visible for about 2 seconds in its passage across the sky, but its trail persisted for 20 minutes. The photograph, taken 1½ minutes after the passage of the meteor, shows the trail as a very irregular sinuous line—the result of drifting in the wind.

Long-range Weather Forecasting, so long discredited by scientific men, appears to be gaining respectability, little by little, with the progress of meteorology. The last annual report of the Dutch East Indian meteorological service mentions the fact that forecasts of the strength and weather characteristics of the easterly monsoon are now issued at Batavia each April. Official monsoon forecasts have been regularly made in British India for many years. In the United States Weather Bureau, Sunday forecasts for a week in advance have become an established institution. Of course in all these cases the forecasts deal with only the broader features of the weather over wide areas.

Cataloguing American Doctoral Dissertations.—The Library of Congress has undertaken the important task of preparing an annual catalogue of the printed doctoral dissertations submitted at the various universities in the United States, exclusive of those submitted for professional degrees. This is a class of literature which librarians and bibliographers find particularly elusive, so that the new publication will fill a long-felt want. Through the co-operation of the university librarians the Library of Congress hopes to acquire copies of all doctoral dissertations hereafter printed in this country, and to print catalogue cards for them. Eventually an attempt will be made to compile a list of the dissertations published before the beginning of the annual publication.

Weather Reports from Arctic Canada.—At the last meeting of the International Commission for Weather Telegraphy, Director Stupart, of the Canadian meteorological service, announced that the Canadian government would shortly be asked, through the Royal Society of Canada, to establish wireless stations at several far northern points, such as York Factory, Fort Chipewyan, Fort Simpson, and in Hudson's Strait. If this is done, arrangements will be made to have daily weather reports forwarded from these places. This would mean a very notable extension of the weather maps of Canada and the United States. Mr. Stupart also reported that his service is now making a daily synchronous weather chart of the northern hemisphere, similar to that prepared in Washington, and that its value in forecasting has exceeded his most sanguine expectations.

Temperatures in the Antarctic.—Some of the meteorological results of Amundsen's antarctic expedition are discussed by Dr. Hann in the *Meteorologische Zeitschrift*. Continuous observations were made at Framheim during the ten months, April, 1911, to January, 1912, inclusive. From these, by comparison with previous records in the antarctic, values for February and March can be computed. On this basis the mean temperature of the station for a year is found to have been -25.2 deg. Cent. (-13.4 deg. Fahr.), which is the lowest yearly temperature heretofore observed at any place on the globe. The lowest individual temperature observed was -58.5 deg. Cent. (-73.3 deg. Fahr.). Much lower temperatures than this have been observed in the "cold pole" of Siberia.

The Remarkable Haziness of the Atmosphere that began in June, 1912, and persisted at least well into the autumn, continues to be the subject of numerous reports from widely scattered points in the northern hemisphere. Dr. A. de Quervain, the leader of the Swiss expedition that crossed Greenland last summer, states that blue skies prevailed on the west coast early in June, before the party started. During the crossing, however, June 10th to August 1st, the members of the expedition were struck by the gray, leaden appearance of the sky, in the absence of clouds, and even when the explorers were traveling at altitudes above 8,000 feet. The Eskimo of the east coast were terrified at this unwanted phenomenon, which they believed to be an omen that the following year would have no summer. A report from Zurich states that the haze ceased to be noticeable at the Swiss observatories about October 11th. Dr. Maurer, president of the International Solar Commission, has sent a circular to the principal meteorological institutions of the world requesting a careful examination of the tracings made by sunshine-recorders during the period in question, as a means of ascertaining the intensity and distribution of the phenomenon. The coincidence of the beginning of the haze with the eruption of Katmai volcano, in Alaska, seems to leave little doubt as to the cause of the phenomenon.

Automobile

Heaviest Military Motor Truck.—The heaviest motor vehicle which has fulfilled all the regulations of the French War Department in connection with the subsidy arrangements, is the Avant-train Latil, which together with the trailer has a carrying capacity of 20 tons.

Automobile Brakes that Operate a Signal.—Charles F. Marston of Great Neck, N. Y., in a patent, No. 1,049,749, provides a signal device which is so connected with the brake mechanism that the signal is operated when the brake mechanism is manipulated to set the brakes, so that an automobile approaching another from the rear will be warned when the automobile in advance applies its brakes to reduce its speed or stop, thus preventing rear end collisions.

Germany Has 825 Subsidized Road Trains.—According to figures which have just been issued by the German government, 120 motor "road trains" have been subsidized for the year 1913 by the kingdom of Prussia, and 15 by Bavaria. This number added to the 690 which were under the control of the government in 1912, there are now 825 of these motor vehicles at the disposal of the German military authorities in case of war.

Next Paris Salon in October.—In view of the fact that heretofore the Olympia Automobile Show at London has been held a few weeks before the Paris salon, the importance of the latter has diminished to such a degree as to make the French exhibit a mere "appendix" to the British show. To counteract this impression and to recapture for France its former high place in the automobile field, it has been decided to hold the next Paris automobile exposition in October, instead of November, so as to antedate the Olympia exhibit.

Accident Statistics for Motor-car-miles.—Someone with a predilection for statistics has figured out that in Great Britain alone about 1,600,000,000 miles are covered annually by all sorts of vehicles, including motor cars. During the past year 750 persons were killed by vehicle traffic, that is to say, one person for every 2,133,333 miles. Motor vehicles to the number of 50,000 covered approximately 300,000,000 miles and killed 200 people, or one person for every 1,500,000 miles.

An Automobile for Forging Rivers.—In order to meet with the rigid requirements of some of the British colonies in respect to motor cars which can be taken anywhere and everywhere, an English manufacturer has brought out a model which can be driven for miles through water four and even five feet deep. All electric conduits, magneto and batteries are protected by special insulations and extra lengths of pipe are attached to the exhaust pipe and to the intake manifold. When a car of this type is driven through five feet of water only the tip of the radiator and the seats show above the surface.

A Daimler Lubricating System.—Patent No. 1,050,108 to the firm of Daimler Motoren-Gesellschaft of Stuttgart, Germany, as assignee of Paul Daimler and Albert Heess of Cannstadt, Germany, shows a lubricating system which has a number of pumps for supplying lubricant to a number of corresponding parts to be lubricated, the pump cylinders being connected in series and to the parts to be lubricated with each cylinder having an oil inlet port and a piston reciprocated in each cylinder and over-running the inlet ports, so that each piston will operate to supply oil to the next succeeding cylinder on the compression stroke of such piston.

Improvements in Carbureters.—It is a pretty well acknowledged fact that the action of many of the carbureters at present on the market is not all it might be from the point of efficiency and flexibility. In this respect it is interesting to note that a number of car manufacturers have obtained a material increase in efficiency by the simple expedient of fitting an auxiliary air valve controlled by the operator. To the person who takes an active interest in his car and its running, the increase in efficiency and flexibility which in many instances can be obtained with the aid of a manually controlled air port, will more than offset the necessity for attention to its proper setting according to the demands of the motor.

New Use for Postal Automobiles.—The Bavarian government has found a new use for the many automobiles employed by the Post Office Department, by means of which the danger of great conflagrations in the rural districts is minimized. If a big fire breaks out in any of the villages farther than ten miles from a city, the fire engines of the nearest city are attached to the postal automobiles and hauled at high speed to the point of danger. As only the larger German cities have motor fire departments, the assistance of the postal motor cars is invaluable to the surrounding villages. The first practical test of the plan was made last month in Bamberg. The village Walsdorf asked the city for help and a small fire engine was fastened to the rear axle of the automobile; the run was made in 34 minutes, and the assistance rendered by this engine was of great value in extinguishing the fire.

Aeronautics

A Proposed Aviation Field at College Park, Maryland.—On January 14th, Mr. Gallinger introduced in the Senate of the United States a bill to authorize the Secretary of War to acquire the land now leased to the United States for aviation purposes at College Park, Maryland, for aviation maneuvers and other military purposes. The sum of \$400,000 is asked to carry out the provisions of the bill.

An Alexander Graham Bell Flying Machine Patent.—In patent No. 1,050,601, Dr. Bell, instead of making the supporting surfaces of a flying machine flexible at their lateral marginal portions and flexing or warping those portions to preserve or restore the balance of the machine, makes such supporting surfaces rigid and non-flexible and employs a vertical balancing rudder which, when the machine is in normal horizontal position, lies approximately in the medial vertical fore and aft plane of the machine. This rudder is mounted on an upright axis, and when the balance of the machine is disturbed, the rudder is by suitable means turned about its axis to incline it to that side of the axis toward the lower side of the machine, the resistance offered by the air as the machine moves rapidly forward, operating to again restore the balance of the machine when the rudder is returned to its normal position. The axis of the rudder is preferably located approximately at the center of pressure of the air acting to support the machine. For operating the balancing rudder, an arm projects from its upright shaft and has a fork which embraces the body of the aviator who, when the balance of the machine is disturbed, naturally inclines his body toward the upper or higher side, thus turning the rudder to the lower side of the machine for the purpose before described.

Recommendations of the Chief Signal Officer of the United States Army.—In his annual report to the Secretary of War, Brig.-Gen. James Allen, Chief Signal Officer of the Army, invites "attention to the recommendation made in previous reports concerning the urgent need of legislation to increase the efficiency of the Signal Corps of the Army. During the past few years the great development in radio-telegraphy, aviation, and in the organization of field signal companies has so greatly increased the duties devolving on the Signal Corps that the present authorized personnel is inadequate to perform the present work of the Corps." He asks an appropriation of \$3,000,000 to be distributed as follows: One million dollars for increasing the present equipment of aeroplanes, hydro-aeroplanes, and other aircraft for the purpose of warfare and national defense; six hundred thousand dollars to be spent for one hundred aeroplanes; two hundred thousand dollars to be spent for maintenance, including service, spare parts, gasoline, oil, etc.; two hundred thousand dollars to be spent for auxiliaries, including hangars, tractors, motor-trucks, etc.; and one million dollars to be spent for the establishment of training schools, known as centers of aviation, on the Atlantic, Pacific and Gulf coasts, on the Great Lakes, and some central interior point, and as many auxiliary centers as it may be possible to organize with a view to having a school of instruction in each State, for the purpose of training officers of the regular army and organized militia as aviators.

Curtiss Awarded Collier Trophy for 1912 and 1913.—Glenn H. Curtiss' flying motor boat, the last word in aviation, and the creation which is said to have made aviation a safer pastime than either automobiling or boating, has won him the distinction, for the second time, of receiving the Collier Trophy, awarded annually for the greatest contribution to the advance of aviation, which shall have been developed and demonstrated during the preceding year. The SCIENTIFIC AMERICAN Trophy was won by him in 1908 when at Hammondsport, N. Y., July 4th, he made the first public flight in America of more than one kilometer. He actually flew a distance in excess of a mile in the old "June Bug." In 1909, almost exactly one year later, Curtiss won the SCIENTIFIC AMERICAN Trophy for the second time at Hempstead Plains, he flew 24.7 miles, or nineteen circuits of a circular course. His famous flight from Albany to New York, the longest flight of the year, won him the trophy in 1910, for the third consecutive time, making him its holder in perpetuity. In 1911 the new trophy, to be awarded for the most signal advance in aviation each year, was offered by Robert J. Collier, then president of the Aero Club of America. It was awarded to Curtiss that year for the invention and demonstration of the single pontoon hydro-aeroplane, the first machine to successfully rise from and alight on the water. There is no record of a single serious accident to the operator of a hydro-aeroplane in America, though one machine and its operators were lost at sea in attempting to fly in a home-built hydro a distance of upward of 400 miles, from San Pedro to San Francisco, starting in a fog following a three days' storm. The hydro-aeroplane perfected by Curtiss has been adopted by almost every navy of the world's powers.

Motoring on Ice

IF by putting skates on his feet a man can outstrip a horse, if by putting runners on a sailboat it can be made to race an express train, why should not an automobile if mounted on runners develop a speed that would satisfy the cravings of the most voracious of speed maniacs? The logic is not perfect. Nevertheless, an automobile has actually been mounted on runners and has attained remarkably high speeds. The experiment we refer to was made by Mr. Fred Waters of Red Bank, New Jersey. He stripped his car of all superfluous weight and mounted the chassis upon two pairs of runners. The rear wheels were left upon their axles, but the tires were removed, and in their place toothed tires were used. The rear runners took most of the weight of the wheels, merely permitting the teeth to dig into the ice and snow and propel the machine. With this novel craft Mr. Waters had great sport traveling over the broad stretches of the Shrewsbury River.

He was not long without rival, however. Mr. Phillips Green, also of Red Bank, came out with a peculiar craft built after the fashion of an iceboat, but provided with a motor in place of a sail. The motor was equipped with an aeroplane propeller. A crude-looking propeller it was, too, and it was driven by a 12 horse-power, 2-cylinder motor. The automobile iceboat, on the other hand, was equipped with a 10 horse-power air-cooled motor. A race was arranged between the two sleds, and the air-driven craft easily showed its superiority over the automobile. One of our illustrations shows the two machines just after the race. However, the automobile was more powerful when it came to traveling through snow, and it was used to drive a snow plow to clear the ice, as pictured in one of the photographs.

One of the speediest of motor iceboats is the "Go-devil," built for Dr. L. Neumann after the design of C. G. Davis. It is fitted with a 40 horse-power, four-cylinder two-cycle motor, water-cooled, and an aeroplane propeller designed to drive the machine at 120 miles per hour. The propeller is placed in front of this boat and the steering rudder at the rear. When this machine was tried out last year at Irondequoit Bay, Lake Ontario, it developed such speed as to astonish the spectators. A reporter who was present was positive that the machine had made 140 miles per hour on the seven-mile stretch of good ice, and this story appeared in the New York daily papers. As a matter of fact the machine was not traveling at its highest speed, but was partly throttled down. The operator of the machine conservatively estimated the speed at about seventy miles an hour with the wind at his back, and he did not feel inclined to let the machine travel any faster on her trial trip at least. Unfortunately, the good ice did not last long, and the next trial had to be made on snow-covered sheet. The snow was five inches deep. But even with this heavy handicap a speed of 40 miles per hour was easily obtained. The accompanying photograph of the "Go-devil" plowing through the snow at this speed, shows how much of its energy was wasted in throwing the snow rather than propelling the machine forward.

Motor iceboating is in its infancy, but it is one of the most fascinating and exhilarating of winter sports, and its development in the past few years offers alluring promises for the future.

Astronomical "Bulls"

THE *Bulletin* of the Astronomical Society of France, otherwise known as *L'Astronomie*, has for some time been publishing, from month to month, delightful specimens of popular ignorance concerning the elementary facts of astronomy, some of which have already been mentioned in our columns. The following are recent additions to the collection: An astronomer happened to remark that he had taken some photographs of the moon through his telescope, whereupon he was asked whether he took them by flashlight. A member of the French Academy, M. Rene Bazin, in his novel "Les Noëlets," the scene of which is laid in Vendée, makes a peasant look up his cottage chimney one summer night, and see, in the zenith, the belt of Orion.

The Waterwheels of Hama

HAMA, in northern Syria, is justly famous for its huge waterwheels. The city lies some 110 miles northeast of Damascus on the banks of the river Orontes. It is undoubtedly a very ancient town, and is referred to in the Bible as Hamath the Great.

The river flows through the city in the form of an S, and upon its banks are four huge waterwheels, each bearing a name of its own. They are used for pumping up the water of the Orontes for irrigation purposes, and also for supplying the town.

The wheels are driven by the flow of the river on what is known as the undershot principle; that is to say, the wheel is moved by water passing beneath it.



Automobile sleigh and motor iceboat just after a race which the latter won.



Twelve horse-power propeller-driven iceboat.



Automobile sleigh clearing the ice with a snow-plow.



The "Go-devil" plowing through five inches of snow.

The largest wheel has a diameter of about 70 feet, and the Syrians declare it is the largest in existence. Like the others, it is built of wood, a dark mahogany. The axle is of iron. The creaking of the wheels is incessant day and night. They never stop. In winter and during early spring the flow of the stream is partially blocked to reduce the rapidity of the revolutions, but on no account are the wheels actually stopped.

Placed upon the banks of the stream amid the trees and gardens for which Hama is justly proud, the wheels present a decidedly picturesque effect. They are the favorite rendezvous of the boys of the town. For

a few cents some of the more daring will climb up the spokes of the moving wheel to the summit and then jump into the stream below him.

Fortunes in Foxes

THE phenomenal expansion of the black fox industry in the province of Prince Edward Island, Canada, has been made the subject of an elaborate report by the American consul at Charlottetown. That province is, it appears, the greatest center for fox-farming in the world, thanks to the possession of a climate and soil that ensure an ideal weight, texture, and color to the skins. More than 80 per cent of all the captive foxes in Canada are kept on Prince Edward Island.

Black foxes (which include the silver foxes) furnish a skin which is not only extremely valuable, but is in such constant demand that its value has become almost as fully standardized as that of the diamond among precious stones, and does not necessarily fluctuate with the supply. These skins frequently fetch from \$1,500 to \$3,000 on the London market, the record price up-to-date being somewhere between \$3,800 to \$3,900. Aside from the industry in skins there has grown up an immense business in live animals for breeding purposes. It is stated that during the past summer \$10,000 a pair was not an unusual price, as compared with \$4,000 a pair for animals of the same quality in 1910. Prices of \$12,000 to \$15,000 a pair are paid for animals that have shown unusual fertility, and it is rumored that a 2-year-old pair recently sold for \$30,000. One of the pioneer ranchmen claims to have refused an offer of \$500,000 for his establishment, coupled with a salary offer for his own services to run it. Fourteen companies for fox ranching have been incorporated in the island, and capital from the United States is beginning to be invested in these concerns. There are now about 50 large ranches stocked with purebred animals; while the number of places where from one to four or five pairs of some variety of foxes are kept is probably more than 300.

All the foxes on Prince Edward Island are now in captivity, the last wild fox having been killed early in 1911. It is claimed that the valuable strains have been improved in domestication. The animals are kept in pens or paddocks about 30 by 40 feet, surrounded by a large outer enclosure sometimes covering an acre or more. The fences are of 16 or 14 gage "fox wire," which is now specially woven for the industry. They are 9 or 10 feet high, with an overhanging wire shelf extending inward, and are sunk 2 or 3 feet in the ground. The kennels or fox houses are inside each paddock, or immediately outside, but opening into it. The mouth of the kennel is a crooked tube or spout, often built to imitate the entrance to a natural burrow.

The diet of the animals is extremely varied, including meat, fish, fowl, small game, mice, and insects; beside various prepared foods, such as hardtack or sea biscuit dipped in milk and patent dog biscuits. Overfeeding must be avoided, especially at the breeding season, but a full diet for a few weeks before the pelt is taken is said to make the pelt more glossy, and is a common practice. Each animal costs from \$10 to \$15 per annum to feed.

The foxes often breed when they are but 8 months old. Each vixen, or female, will breed 8 or 10 times in the course of a lifetime, and a litter contains from 2 to 7 or 8 pups, the usual number being about 4. During the mating season the animals are exceedingly wild and shy; and, in fact, at all seasons, the fox is a very sensitive and high-strung animal, so that a great deal of experience is needed for its successful handling.

The recent rapid development of this industry has raised a number of difficult problems, which are gradually being solved. There is at present considerable agitation on behalf of some kind of registration of purebred island foxes, looking toward the formation of an association of breeders for the purpose of establishing a species of "herd book," in which to record pedigrees of valuable animals. It is expected that ultimately this task may be undertaken by the Live Stock Branch of the Dominion Department of Agriculture.

Our Latest Battleship "Pennsylvania"

The Largest, Most Powerful and Best Protected Battleship in Any Navy

IT is the policy of our Navy Department to build its new battleships in divisions of five, and to make these ships in every respect identical. It is part of this policy to send each of the ships of a division in turn to a navy yard for overhaul and general refitting, leaving the fleet in commission made up of so many divisions of four ships each. The Department asks annually for a sufficient appropriation to enable it, among other things, to build so many ships of a certain type. Usually, Congress appropriates the money, more or less, leaving the question of design to the discretion of the Department, where it properly belongs. Occasionally, however, Congress has gone out of its way and specified what size or type of ship it desires. This is always disastrous; for it interferes with the Department's regular programme of construction and arbitrarily introduces into the fleet a ship or ships, which, because of differences in size, speed, turning circle, or arcs of training, cannot maneuver effectively with the ships of the divisions to which they are allotted. The "Idaho" and "Mississippi" are a case in point. They are small "Connecticuts," of 3,000 tons less displacement, a couple of knots less speed, smaller radius of action and other differences which greatly mar their usefulness.

When Congress appropriated last year the sum necessary for the construction of one unusually large battleship—some 3,500 tons larger than any existing ship in our fleet—the Department was confronted with the old problem, and had to determine whether to make the "Pennsylvania" come into the class of the "Nevada" and "Oklahoma," authorized the year before, or to constitute her the first of a new type. The "Pennsylvania" is an enlarged "Nevada," and in outward appearance is so like that ship, that, to any but the experienced eye, she will look, when she is steaming in division, to be practically identical. She will be forty feet longer, of about two feet more beam and a little more draft. Two guns will be added to the armament, giving her the powerful battery of twelve 14-inch guns. Like the "Nevada" and "Oklahoma," she will have oil-burning boilers of the water-tube type, and, probably, she will be turbine driven. Her armor will be somewhat heavier, and as the "Nevada" and her sister are admittedly the most powerfully protected ships as yet

be, of course, an increased weight of ammunition. A large part of the 3,500 tons also will be consumed by the increased length of the ship and the greater weight of the frames, decks, beams, and deck plating, due to her increase of beam. Then there will be a very large consumption of weight due to the increased length of the side armor. There will be a slight thickening up of the armor plan over that of the "Nevada." Furthermore, the boiler and engine plant must be enlarged

are joined by transverse bulkheads of heavy armor. The barbettes are 14 inches in thickness. The sloping port plates of the turrets are no less than eighteen inches thick. The roof armor has been thickened to five inches.

To protect the base of the single smokestack and prevent the escape of poisonous furnace gases between decks, heavy armor is carried around the base.

The battery of torpedo defense guns is without any armor protection whatsoever. To place relatively thin armor on this battery is to make certain the bursting of armor-piercing shells, which might otherwise pass entirely through the thin plating of the ship.

Because of the wider space available due to the absence of side bunkers, the boiler rooms are placed together under one large central smokestack.

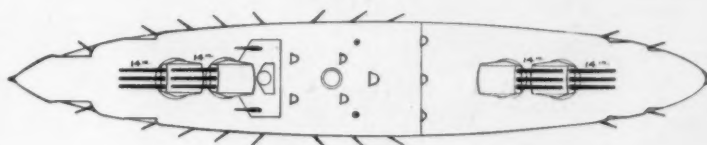
No attempt will be made to utilize additional displacement of the ship for any great increase of the motive power and speed. The speed will be only a little greater than that of the "Nevada" and "Oklahoma," or say, about 21 knots.

The "Pennsylvania," therefore, will be an enlarged and considerably more powerful "Nevada." Her guns will have the same arcs of training and she will be so designed that she can maneuver with the same turning circles, etc., as her smaller sister. If Congress appropriates, this year, for two more "Pennsylvanias," we shall have a division of ships which cannot be matched in any navy of the world.

The "Pennsylvania" embodies the combined experience and judgment of the sea-going officers and the naval constructors, and the Department is to be congratulated in having produced such a fine compromise of the many conflicting requirements of the modern warship.

Protection of Wooden Poles Carrying Electric Wires Against Decay

IN *L'Industria*, M. Mayer proposes to protect that part of the pole sunk in the ground, by encircling the critical zone of the pole (surfaces of contact between air and ground) for a variable height from 16 to 40 inches, according to the humidity and nature of the soil, with a round sheet of iron, having a diameter of from 8 to 16 inches larger than the pole, so as to leave



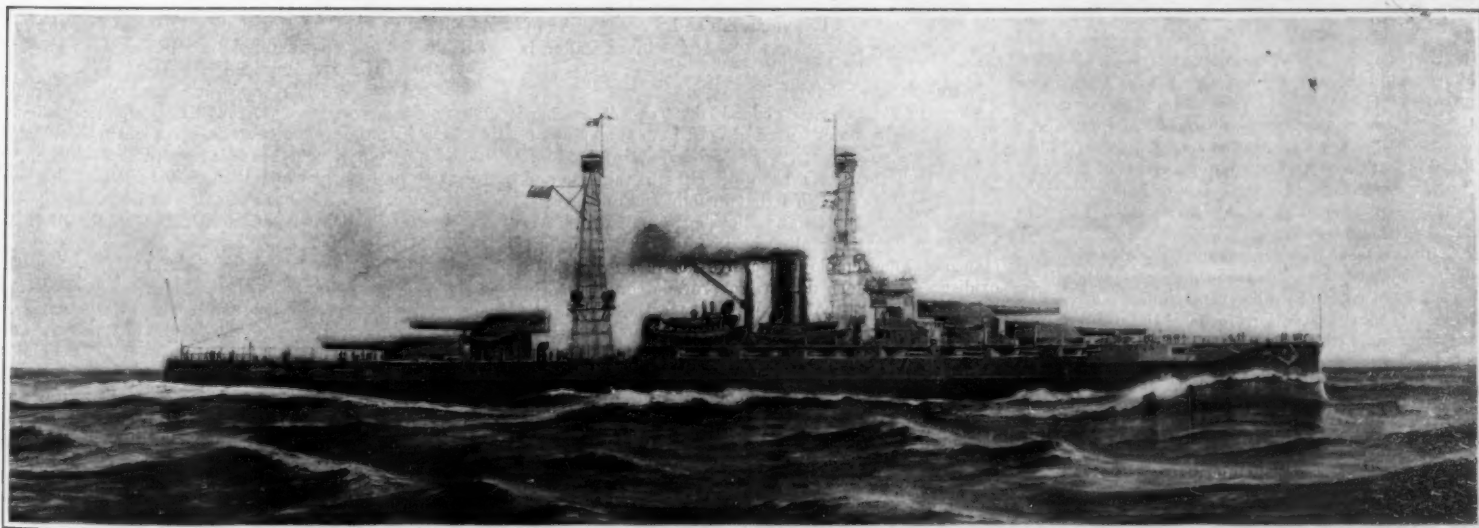
Deck plan of the "Pennsylvania."

somewhat to drive the heavier ship; although the fanning out of her lines, due to her greater length, will go far to offset the increased load. Finally, and very important, will be the larger fuel supply with the considerable increase which it will give to the radius of action.

The disposition of the turrets will be similar to that of the "Michigan," which, by the way, affords the most efficient distribution of the guns for securing a maximum of all-round fire. There will be two three-gun turrets above the fore-castle deck, the after guns training above the roof of the forward turret, and there will be a similar pair of turrets aft. This will give an end-on fire, both forward and aft, of six 14-inch, and a broadside fire of twelve 14-inch guns.

The three guns in each turret will be mounted in a common sleeve, so that they will be elevated together and the three shells, if there is no variation in the powder, must fall absolutely together—a matter of great assistance to the spotter. There will thus be four gun pointers in place of twelve, and errors of range should be greatly diminished. The torpedo-defense battery will consist of twenty-two 5-inch guns, carried chiefly on the main deck, about twenty-two feet above the water line. The armament will also include four submerged 21-inch torpedo tubes.

In a recent discussion of dreadnoughts before the



This "super-dreadnought," 625 feet long, will carry twelve 14-inch guns behind 18 inches of armor in four 3-gun turrets. In gun power and armor protection she is the most powerful ship in any navy.

The latest U. S. battleship "Pennsylvania" of 31,000 tons.

designed, the "Pennsylvania," because of her size, gun-power, and efficient protection, will take rank as the most powerful dreadnought built, building, or authorized by any of the leading powers.

The principal dimensions of the ship are: Length over all, 625 feet; beam, 97 feet; draft, 29 feet; and displacement on this draft, 31,000 tons. This last will be her trial displacement, and it represents the flotation of the "Pennsylvania" when she is carrying two thirds of the full supply of stores and fuel and a full supply of ammunition. Her full load displacement will be 32,500 tons.

The "Pennsylvania" will be no less than 3,500 tons larger than the "Nevada." A part of this weight will be consumed by the two additional 14-inch guns and the greater weight of the two three-gun over the two two-gun turrets which they replace. There will also

Society of Italian Architects, a distinguished officer stated that the dreadnoughts of the United States Navy were better protected than those of any other navy. Unquestionably this is a fact, and it is our decided opinion that the policy of making the protection of the flotation of the ship and her main armament of paramount importance will stand us in very good stead when it comes, if it ever does, to the trial of a line-of-battle engagement.

The hull of the "Pennsylvania" is most fully protected. The main belt is eighteen feet in depth and fourteen inches in thickness; it extends far below the waterline. At the foot of it, from the armor shelf springs a 2-inch protective deck, which slopes upwardly to about the level of the waterline. At the top of the armor belt is an upper protective deck. The main belt extends to near the ends of the ship, and its extremities

between the outer surface of the pole and the inner surface of the sheet an empty space, which is to be filled with a melted product derived from the distillation of tar and which boils at about 300 deg. Fahr. This product penetrates and saturates the critical zone of the wood and after is solidified in a uniform and compact layer, retaining, however, the necessary elasticity to follow the vibrations of the pole, at the same time protecting it from water and insects. Poles which have been already attacked by rot, and should be exchanged, may give further use by excavating the ground around them, scraping off the decayed part, burning it superficially with coal oil or kerosene and using the above described method. If it is necessary to remove a pole so protected, all there is to be done is to excavate the ground at one side, heat the sheet of iron until the mass inside is melted and extract the pole.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Card Trick

To the Editor of the SCIENTIFIC AMERICAN:

In reference to the article "Another Card Puzzle," which appeared in the October 5th, 1912, issue of the SCIENTIFIC AMERICAN, I would advise those interested that the trick, as I call it, can be done with any number of piles of cards from one to five inclusive, the latter number being the best, as there would be fewer cards left, and if the face cards are valued at ten each, three added to the number of cards left will give the total of the bottom cards on the five piles.

To make this trick seem more mysterious, ask the party counting to put two cards on each pile, then one on each, or two on the first and second piles, and so on, in any manner that you wish, until the cards remaining have all been used. This is done to find out the number of cards without asking for them or without letting anyone know that you must have the number. I find that this adds immensely to the effect of the trick.

New York city.

R. W. HOEL.

Required, a Machine for Shaping Granite Cubes

To the Editor of the SCIENTIFIC AMERICAN:

A pavement somewhat similar to that which has been in use in the streets of Liverpool for a number of years past has recently been laid in Fulton Street in this city. This pavement, which consists of small granite cubes some three or four inches across, accurately cut so as to admit of laying with close joints, seems to be better adapted than any other to meet the requirements of heavy street traffic, and at the same time affords a good footing for animals. The chief obstacle to its extensive use lies in the fact that the cost is considerably greater than most other forms of pavement.

It has occurred to me that these granite cubes could be produced at a lesser cost if labor-saving machinery were employed in shaping them. Would you kindly call this requirement to the attention of inventors throughout the country, in the hope that they may be able to solve the difficulty?

HENRY BERGH,

Chairman Committee on Improved Pavement.

New York, N. Y.

[If the cubes are shaped by hand, their relatively high cost is readily understood. It should not be difficult to devise suitable machines for doing this work.—EDITOR.]

Determining Differences in Longitude by Wireless

To the Editor of the SCIENTIFIC AMERICAN:

The paragraph in your issue of October 5th regarding the proposed use of wireless by the Belgian government for the exact determination of difference of longitude, induces me to remark that this device was successfully employed last summer by Canadian government vessels. The work was performed by the "Aretic" and "Minto," and consisted in the charting of the Button Islands at the entrance to Hudson Strait.

While one vessel remained at anchor, the other visited the various islands which compose the group. Each day (the weather permitting) observers from each vessel made careful shore observations for local time, and then, as soon as possible, these times were compared by wireless.

The distances involved ranged from thirty to fifty miles, and it was found that by pressing the key at intervals of a minute for four or five minutes, an accuracy in transmission considerably greater than that of the observation itself could readily be attained.

The method proved satisfactory in every particular, and its rapid extension seems assured.

Berlin, Ontario.

W. B. WIEGAND.

The Carob Bean Tree

To the Editor of the SCIENTIFIC AMERICAN:

Your interesting article on "The Carob Bean Tree" in the January 11th issue of your highly esteemed paper reminded me of my observations of this tree. It grows here in a wild state, both the bean-bearing and the male tree. The latter is used for posts of various kinds, is very durable and hard, also rapid growth. The female develops less rapidly and has thorns from eight inches long down to very small ones on the smaller branches. The beans or pods are flat and black and measure as long as sixteen inches and about one and one half inches wide; the honey lying in the thicker portion of the pod and the beans in the thin. I have seen them over eighty feet in height, and the lumbermen call them "black locust." I know of a row of the male locusts near here, about one quarter mile long which were originally posts for a wire fence, and were allowed to grow into trees now about fifty feet high. I have also seen telephone posts made of

this variety, which developed into beautiful trees. They bloom in early spring, with great clusters of pendulous, creamy white and very fragrant blossoms; the foliage is also very graceful. Cold does not affect this tree here. The Louisiana orange is grown some four hundred miles south of us, and does not stand our climate. This tree is very hard to kill by cutting down, as it will invariably put out not only suckers from its most abundant roots, but will also sprout from the stump. The soil here is rich and sandy below the surface, with a good layer of rich black topsoil; the lowest stratum is gravel of an exceptional quality. In my younger days we would bind the long hard thorns to a lance of bamboo cane and use them for snake spears, and with their many tough prongs they answered admirably for this purpose. Incidentally I have used a smaller thorn in place of a lost suspender button, the utility of which can be imagined. The male locust is also known here as "locust and wild-honey" tree. Negro children sometimes eat the honey portion, but it is never used as a food. Neither the male nor female trees are ever green here, and we are perfectly bare of trees now. I have seen these trees in Miami, Florida, in Arkansas, Tennessee, Texas, and Louisiana, besides my home State, Mississippi. It is interesting to know that there is more value attached to this tree than was supposed here.

I send you this little article for what you may wish to do with it. I have had the benefit and pleasure of being a subscriber to and reader of your valuable paper for twenty years, and I still look for its weekly advent with pleasant anticipation.

F. F. BESSAC.

Natchez, Miss.

Misuse and Failure of Metals and Alloys

To the Editor of the SCIENTIFIC AMERICAN:

In order to bring about a better understanding between the users and manufacturers of metals and alloys, I venture to request the favor of the insertion of this letter. I hope it may provoke discussion, and if possible help us to arrive at the truth.

Users, including the non-expert public, of metals and alloys in general do not sufficiently realize that many of their corroded metallic wares, for example copper pans and boilers, mysterious breakages of for instance chains, railway accessories, and sudden failures of condenser tubes and copper pipes, are due to two easily preventable causes described below.

In order to satisfy the demand for beauty of form or the modern craving for cheapness, many ingenious mechanical devices have been evolved by manufacturers' works staffs, which put upon the metallic articles, while being made, uneven strains, or introduce in antiquated furnacing appliances deleterious compounds, which tend to and, in varying times, finally render the articles useless in the hands of the purchasers or users. Often enough they are dangerous to human life and property. An attempt is made to remove these strains by annealing in unevenly heated furnaces.

Why this state of things?

One must reply, "general ignorance," perhaps "apathy"—the major causes of most human troubles.

A few manufacturers, whose products are subject to constant physical tests, are quite alive to the situation. It must also be conceded that manufacturers of ferrous and non-ferrous metals and alloys spare no pains to free them while in the molten state from deleterious substances. They employ expensive means known as deoxidizers—ingenious devices to prevent contact of the liquid metal with the air during the casting operations, all tending to produce soundness in the ingots or castings, i. e., to free them from blowholes and segregations.

No sooner is this desirable end attained than the metal or alloy is introduced into furnaces wherein hot gases containing free oxygen, sulphur, and other objectionable elements are allowed to impinge upon or envelop the metal. While hot, they are brought out of the furnace into the air and mechanically treated in an atmosphere containing oxygen. This operation is often repeated several times. In cases of cold working, the metal, with few exceptions, is annealed between processes in furnaces to which the air has access. After this heat treatment they are withdrawn and allowed to cool, sometimes in approximately closed receptacles, oftener in the air. Not only is the surface of the metal oxidized or tarnished, but during the whole time of heating, and partly in cooling, solution of oxygen and other gases takes place, with formation of compounds in intergranular spaces, or in the body of the metal or alloy, which form centers or areas of corrosion when in use.

In the last year or two, exact investigations and experience have proved beyond doubt that both the above defects in heat treatment are prolific causes of corrosion and the other breakdowns.

I therefore with all respect beg leave to submit that the time has arrived for all engineers and users of metals and alloys to insist and specify that, at least, two causes of failure of metals and alloys under the control of the makers shall be removed, namely: (a) Uneven heating appliances. (b) Antiquated heat treatment in chemically and physically active atmospheres.

Incidentally the public health will benefit, because all the appliances on the market capable of bringing about the above results are smokeless when in operation. The present unnecessary and wicked waste of one of our natural resources, viz., coal, will also be curtailed.

T. VAUGHAN HUGHES, A.R.S.M.

Birmingham, England.

Bursting of 13.5-inch and 14-inch Guns

To the Editor of the SCIENTIFIC AMERICAN:

In your number of December 14th last, when speaking of the bursting of an English 13.5-inch gun, which had taken place in Shoeburyness a few days previously, you alluded to the fierce controversy which had taken place a few years ago, respecting the question of the relative strength of the wire-wound guns and hooped guns. Starting from the justified assumption that the English gun which burst was wire-wound and of the most recent pattern, you recalled to mind that "the advocates of wire-wound construction claim, or did claim, before the recent improvements in hooped guns, that the wire-wound gun, because of the absolute inspection to which every part of it could be subjected, was proof against the kind of accident which recently happened at the proving ground."

From the wording of the article it results clearly that you had doubts as to whether the claims of the manufacturers of wire-wound guns were well founded, and I presume that these doubts will have been further strengthened by the bursting of a 14-inch wire-wrapped gun which took place at the Sandy Hook proving ground on December 9th. As appears from the *Army and Navy Journal* of December 14th, the gun, after having fired a first shot with reduced charge, burst at the second discharge with a normal charge of 320 pounds powder and a projectile of 1,660 pounds, producing a pressure of 42,000 pounds per square inch; while the contract strength of the gun called for a minimum of 55,000 pounds.

This is quite an extraordinary event, which, taken together with that which had taken place in England, where the 13.5-inch gun burst at the seventh discharge, shows that the criticism against the wire-wound guns is well founded, and that it is, in fact, not true that the latter have a circumferential strength greater than that of the hooped guns.

That the wire-wound guns are very defective as regards longitudinal strength is a matter which is now so well known that there is no need to demonstrate it, and in connection therewith it will be sufficient for me to refer to the important article which was published on this subject in the February-March number of the *Journal of the United States Artillery*.

As regards the circumferential strength, I beg to call your attention to the two important essays which were published in the "Memorial de l'Artillerie Navale" of 1912 by the ordnance and naval engineers Messrs. Léon Coupaye and Pierre Malaval.

These two gentlemen have exhibited, by different methods and procedures, the following principle: "Whatever may be the system according to which a compound gun is constructed, whether it is hooped or wire-wound, the internal pressure which it can resist without altering its shape permanently has as its upper limit the value of the limit of elasticity of the metal of which its internal tube is manufactured."

Thus, for instance, a gun the inner tube of which is manufactured of a metal with a limit of elasticity of 40 kilos, cannot resist, without a permanent deformation, an internal pressure exceeding 4,000 kilos per square centimeter (56,891 pounds per square inch). This limit of internal pressure can, however, be reached only in case the internal tube is of infinite thickness; it is less in practice, and decreases with the thickness of the tube.

In the wire-wound guns, the internal tube is of small thickness and strongly compressed by the steel ribbon surrounding it externally. The limit of elasticity of the ribbon is superior to that of the tube, and consequently, under a given pressure, the latter suffers an elongation greater than that of the ribbon. When the entire arrangement returns to its state of repose, the tube can no more retake its former dimensions, because it does not find the necessary space to do so and, consequently, contracts or breaks. The contraction of the internal diameter of the wire-wound guns is a well-known phenomenon which I have personally ascertained; it has been, may be, and will be the cause of the jamming of the projectile in the bore, and of the consequent bursting of the gun.

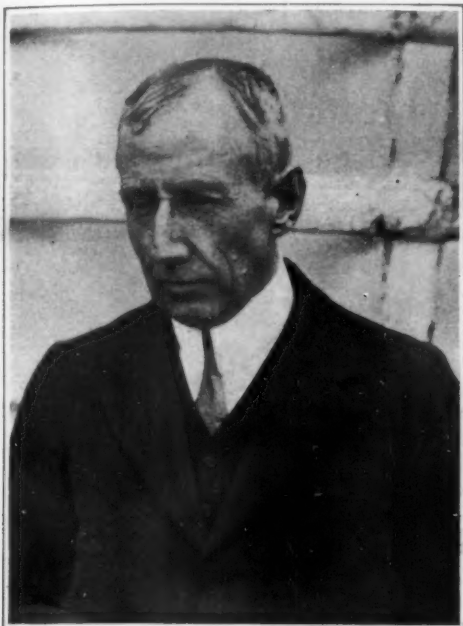
I think that to this cause must be attributed the bursting of the English 13.5-inch gun, as well as that of the American 14-inch gun, and it seems to me that these two accidents, which took place within a few days of each other, must give rise to serious thoughts.

Torino, Italy.

ETTORE BRAVETTA,

Captain Italian Royal Navy (retired).

[The theory of our correspondent regarding the cause of the bursting of the 13.5-inch gun is decidedly interesting. He is wrong with regard to the American 14-inch gun, whose failure was due to other causes which we are not at liberty to disclose.—EDITOR.]



Photographs copyrighted by Underwood & Underwood.
Capt. Roald Amundsen, who discovered the South Pole on December 14th, 1911, and who was at one time only five days' journey from the ill-fated Scott party.



Sir Ernest Shackleton, who was Scott's second in command on the expedition of 1901-1904, and who led a party of his own to a point within 97 miles of the South Pole in 1909.



Capt. Robert Falcon Scott, who discovered the South Pole on January 18th, 1912, and who perished with four companions on his return journey.

Three explorers who have made Antarctic history.

The Scott Expedition and Its Tragic End

A Sacrifice Made for Scientific Ideals

IN the desolate, icy waste of an unexplored Antarctic country Capt. Robert Falcon Scott gave up his life, after having reached the South Pole. He died a true hero of science. There was no buried treasure to seek in those untrodden southern snows—nothing but everlasting fame. Only those who are engaged in scientific research can understand the ideals of a man who willingly cuts himself off from the world for a period of three years and perishes in a blizzard—for what? For meteorological information, for geological data, for light on the fauna and flora of a cold, white, silent land that will probably never be peopled, for a handful of rocks and fossils that will show the relation of the Antarctic Continent to South America and Australia, for a study of the southern atmosphere and the southern seas, in a word, for things that are infinitely removed from gold hunting.

Let it not be supposed that the cause in which Scott died was the mere attainment of the South Pole. If that "athletic feat," as it has been termed, were the only object of polar exploration, scientific societies would not contribute a penny to the equipment of an expedition. Nor would men of Scott's and Shackleton's attainments be interested in it. A polar dash makes good newspaper reading, but your scientific geographer looks primarily for some addition to the world's knowledge.

The Great Unexplored Antarctic Continent.

Until the close of the nineteenth century there was no part of the world about which less was known and none about which so little interest was manifested as Antarctica. The reason is to be found in its distance from the centers of wealth and thought, in its dearth of animal and vegetable life, and in its unpeopled state. The game hunter, the daredevil explorer seeking adventure, found little to attract him in that bleak and barren country. It was a region that held a fascination only for the scientifically inclined man, and hence we find that most of the men who have braved its terrific blizzards have been men of the finest scientific type.

Definite knowledge of the Antarctic regions was acquired very late in the nineteenth century. Indeed, to Capt. Scott belongs the credit of having first penetrated Antarctica during his first expedition of 1901 to 1904. Before that

time geographical knowledge of the South Polar regions was confined largely to sea approaches. To be sure, Palmer Land with its associated islands, the coast of Victoria Land with the adjacent Ross Sea, and to a lesser extent, the coast of Wilkes Land, had been explored; but of the great Antarctic continent as a whole, practically nothing was known before Scott's first expedition returned. True, the examinations of the "Belgica," the "Francais," and the "Pourquoi Pas" showed that Palmer Land extended away to the southwestward along the southern confines of the Pacific Ocean; and the German "Gauss" Antarctic Expedition confirmed the discoveries of Wilkes, made in 1840, and so long discredited. But the first who really scaled the Great Barrier and gave us some idea of a continent whose present unexplored and unvisited extent is still twice the area of Europe, was Scott. Thanks to his studies, supplemented by those of

Shackleton, we know that in former geologic times the continent was probably connected with Africa, South America, Australia, and New Zealand, although not with all of them at the same time. The first phase of any journey which has for its object the exploration of this vast territory, must be over the plateau of the Great Barrier, the second a climb through mountain passes, and the third a traverse of a lofty inland plain. Not all the explorers who managed to ascend the Great Barrier could take any means of transport with them. Sir Ernest Shackleton had to advance with the unaided efforts of man alone. His party started on the second phase with full loads, and achieved what is probably the maximum that could be accomplished under such circumstances. Amundsen was able to use dogs, because of the more or less favorable conditions which he encountered. Perhaps to that fortunate circumstance his success may in large measure be attributed.

But even if ponies, dogs or motor sledges can be used, it must be remembered that the last phase of the journey, owing to the height of the plateau, must inevitably be accomplished under climatic conditions which for severity are unequalled either in the Arctic or Antarctic regions. Polar exploration must be conducted with a technique of its own, a technique that differs at both extremities of the earth, for the simple reason that the topographical conditions are not the same. In the north we find islands and a polar sea; in the south an austral continent surrounded by an enormous floating ice cap, which is called the Great Barrier, and which covers probably more than 150,000 square miles of the Antarctic Ocean. Sledging is, of course, necessary in both regions. In the north it is not possible to travel by sledge over the frozen sea, except during a short period in spring. In the south, sledging is more or less possible at all seasons, except that the meteorological conditions are more favorable at some times than at others.

The Importance of Equipment.

Next to the personality of the leader equipment is the most important element in the success of polar exploration. The Japanese expedition under Lieut. Shirase failed because of its poor outfit. Amundsen was not equipped nearly so well as Scott. Personal courage and will counted for more in his



The South Pole lies on a lofty eminence. How it was attained by Amundsen on December 16th, 1911, and by Scott on January 18th, 1912, is indicated on this map, together with Shackleton's course in 1909.



Amundsen's dog teams and sleds plodding along toward the Pole. This picture was taken by Amundsen only a few miles from his goal.



Photograph of Lieut. Helmer Hansen, taken by Capt. Amundsen at the South Pole with one of the dog teams.

case than anything else. Lieut. Filchner, the head of the German expedition now in the South Polar regions, conducted his undertaking with true German deliberateness. First he carried out an elaborate campaign of oceanographic work out in the South Atlantic, and then a series of very interesting meteorological observations with sounding balloons in South Georgia. Finally on the 10th of December, 1911, his ship, the "Deutschland," set sail for Antarctica, where he expects to remain until the winter, that is the southern summer 1913-14. The "Deutschland" is equipped with wireless.

It may be that Lieut. Filchner's expedition is better equipped than that which Capt. Scott led. On the other hand, we are informed that Scott spared no time, energy or money in order to fit out his part. By popular subscription the sum of \$200,000 was raised. He selected for his ship the "Terra Nova," the largest and the strongest of the old Scottish whalers. Built at Dundee in 1884, she is 187 feet in length and 31½ feet in beam, and is considered the best ship ever launched for the Greenland whale trade. Of late years, because of a decline in the whaling business, she has been engaged in seal hunting in the northern waters, sailing from St. John's, Newfoundland.

The "Terra Nova," however, has not confined herself to the humdrum of trading. In 1903 she was purchased by the Admiralty as a relief ship for the "Discovery" expedition, and, after being considerably strengthened, she duly made her appearance in Ross Sea. The year 1905 saw her in the service of a North Polar expedition, on a visit to Franz Josef Land. Thus she has ranged from the great ice barrier in the south to the North Polar pack—from extreme to extreme of the navigable waters of the globe. The size and strength of the ship make her a



In the foreground can be seen one of the great crevasses, which had to be crossed by the snow-bridge in the center, during Amundsen's dash for the Pole.



"Framheim," one of the camps of the Amundsen expedition, used as a base of supplies.

fitting receptacle for the extensive equipment which it is necessary she should carry for success.

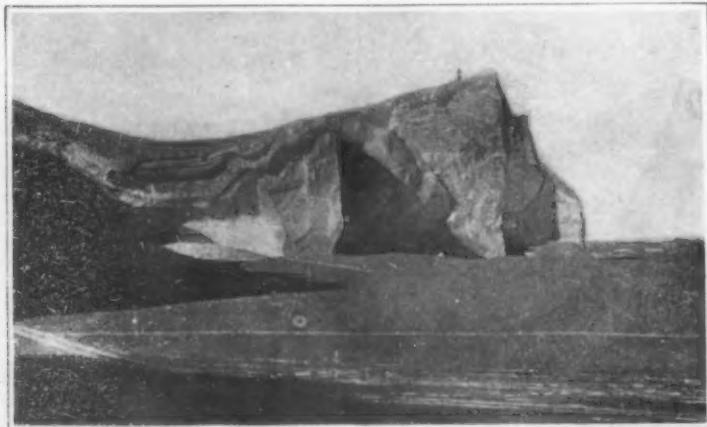
Scott's Equipment.

In equipping his expedition Capt. Scott displayed painstaking care. He laid great stress on the fact that the newly devised motor sledges offered a new means of ice travel, and three such sledges were stored in the hold of the "Terra Nova," as well as an equal number of the more familiar dog sledges. In a final statement before the expedition started Capt. Scott thus summarized the difficulties of Antarctic travel:

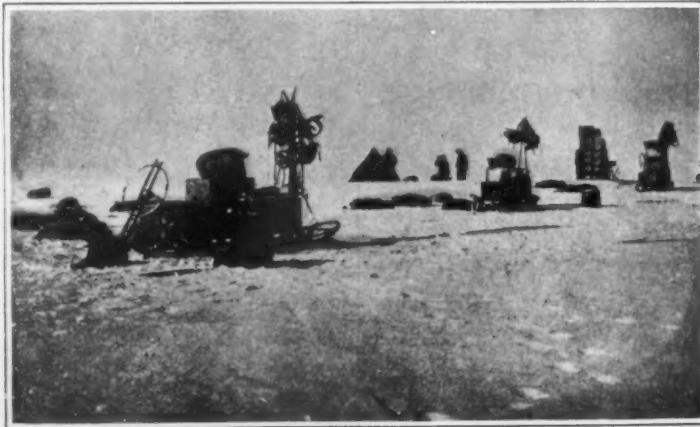
"The problem of reaching the South Pole from a wintering station is purely one of transport. The distance to be covered there and back is about fifteen hundred miles. The time at the disposal of an explorer in a single season never exceeds one hundred and fifty traveling days. An average of ten miles a day can easily be maintained by men of good physique, provided adequate transport facilities are made.

"There are three means by which the traction for heavy sledge loads can be provided, viz., ponies, dogs, and motors. As a result of two years' experiments, a motor sledge has been evolved which has undergone satisfactory trials on the snows of Norway. A motor was recently taken on Mr. Shackleton's expedition, and it is instructive to note that it was found possible to run it in the lowest temperatures. Its use on a prolonged journey was prohibited only by the fact that its wheels were not sufficient to support it on the soft snow of the Barrier.

"The plan for the journey to the south pole from King Edward VII. Land includes the use of the three means of sledge traction described. Ponies will be taken in sufficient numbers to insure a thoroughly adequate supply of food, and will be used for transport to the foot of the glacier; a dog team with a relay of men will transport the loads over the glacier surface, and a picked party of men and dogs will make the final dash across the inland ice sheet. Motor sledges will be used, according to their proved capacity, as a main agency or useful auxiliary to the transport plan. If they reach the foot of the glacier there is little doubt that they will ascend it



The juncture of the Great Barrier and King Edward VII. Land. The Barrier here appears about 300 feet in height.



One of the camps established by the Amundsen South Pole expedition on the way to the Pole.

On the way to the South Pole.

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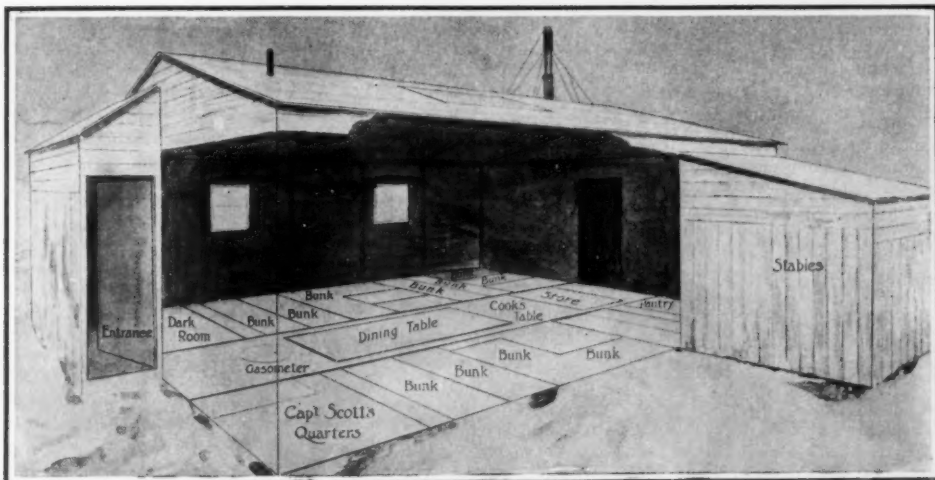
and greatly simplify the difficulties of the remaining journey. If they fail to reach the glacier they will, at least, as far as they can be taken, relieve the ponies and dogs of the weights, and increase the safety of the return journey, as they can be cached, when no longer available, to await the return of the party."

Scott's Programme.

In a lecture delivered in London before his departure, Scott presented the following programme:

HOW CAPT. SCOTT MAPPED OUT AS FAR AS WAS POSSIBLE
THE TIME TABLE OF THE BRITISH ANTARCTIC
EXPEDITION.

Departure from London	June 1st,	1910
Cardiff	June 15th,	1910
Cape Town	August 1st,	1910
Melbourne	September 13th,	1910
New Zealand	October 13th,	1910
Leave New Zealand	end of November,	1910
McMurdo Sound	end of December,	1910
Landing of winter hut and provisions of western party (twenty-two to twenty-five persons in number)	December 22nd,	1910
Starting off of this party	about January 21st,	1911
King Edward's Land reached, if possible, early in	February,	1911
Establishment of second hut and traveling equipment for party of six men on King Edward's Land	February,	1911
Caches of provisions to be left on edge of Great Ice Barrier to form link between eastern and western parties	February,	1911
"Terra Nova" to turn northward about	February 21st,	1911
Investigation of the pack in the region of the Balleny Islands, and to proceed to the westward through, or to the south of, those islands	March,	1911
Depots laid well to the south on the Great Ice Barrier	April,	1911
Start for the South Pole to be made during the month of	October,	1911
Barrier to be traversed and the Beardmore Glacier ascended	during October and November,	1911



By courtesy of *The Sphere*.

The hut in which the 1910 expedition lived after the ship landed them on the Antarctic continent. The internal arrangements are here only approximately given, as the final divisions of the hut were settled on the Antarctic snows.

Upper plateau to be reached early in December, 1911
South Pole to be reached, if possible, on December 22nd, 1911

Adverse conditions prevented him from living up to the schedule. He was delayed from four to six weeks in making the preparations for his polar dash.

The Journey to the Pole.

Scott's actual start for the pole began on November 2nd, 1911, later than he expected. His plans and hopes were last described by himself, and the version was brought back by the "Terra Nova:"

"The pony party, consisting of myself, with Wilson, Oates, Bowers, Garrard, Atkinson, Wright, Evans, Crean, and Keohane, will start about November 1st. Independently of the success of the motors, ponies will be worked with light loads in easy marches to Corner Camp, with full loads and easy marches to One Ton Camp, and with such pressure as necessary thereafter. Dog teams starting will rejoin us at One Ton Camp and help to advance loads. By these means we hope to get thirty units of food to the foot of Beardmore Glacier, a unit being a week's provision for four men. Then, with three divisions of four men and twenty-one units of provisions, I hope to extend the advance to the required distance. If the weather conditions are not wholly unfavorable.

"Of the ten remaining ponies one is unreliable and one doubtful, the remainder being in very fine form. Officers and men are in splendid health and eager to go forward. Owing to my decision to postpone there is an obvious chance that the most advanced southerly party will be unable to reach the "Terra Nova" before she is forced to quit the Sound. Under these conditions, having regard to important scientific work done and facilities offered for further work, I have decided to maintain the station for a second year. The majority of the shore party will probably remain, but details depend upon the date of our returning from our journey, on home news and the extent of fresh transport provided."

On November 24th Capt. Scott wrote that the party arrived at Corner Camp. Just before One Ton Camp was reached the dog sled party caught up with Capt. Scott's party and they journeyed in company. They passed the abandoned motor sleds, and when they found the motor party waiting at latitude 80½ they learned the motors had been left behind because of the overheating of the air-cooled engines.



Capt. Scott (seated) and his first officer, Lieut. Evans.

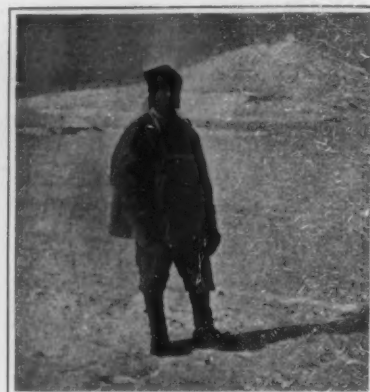
Capt. Scott, on January 3rd, 1912, when he was one hundred and fifty miles from his goal, wrote of his plans in a message he sent back. He said:

"I am going forward with a party of five men, sending three back under Lieut. Evans with this note. The names and descriptions of the advance party are: Capt. Scott, R. N.; Dr. Wilson, chief of the scientific staff; Capt. Oates, Inniskillen Dragoons, in charge of the ponies; Lieut. Bowers, Royal Indian Marine, commissariat officer; Petty Officer Evans, R. N., in charge of sledges and equipment.

"The advance party goes forward with a month's provisions, and the prospects of success seem good, providing the weather holds and no unforeseen obstacles arise."

The Tragic End

Capt. Scott and the four men with him reached the



By courtesy of *Illustrated London News*

Capt. R. F. Scott in polar costume.

from concussion of the brain, on February 17th, 1912. Dates from exposure on March 17th, 1912. The remaining three men made their way back to within 155 miles of Cape Evans, when they were caught in a blizzard that must have lasted nine days, and were overcome about March 29th, within eleven miles of the shelter and supplies at One Ton Camp.

The relief expedition recovered the records of Scott. He had found the tent and documents left by Capt. Amundsen when the Norwegian left the pole about a month earlier.

Scott's total distance to the pole and back was 1,842 statute miles.

The death of Capt. L. E. G. Oates of the Sixth Inniskillen Dragoons was heroic in every sense of the word. Despite his badly frostbitten feet and hands, he struggled on manfully. On March 16th his comrades knew that he was doomed. For weeks he had suffered intensely without complaint. No wonder that Scott wrote in his diary:

"He was a brave soul. He slept through the night hoping not to wake, but he awoke in the morning. It was blowing a blizzard. Oates said: 'I am just going outside and may be some time.' He went out into the blizzard and we have not seen him since."

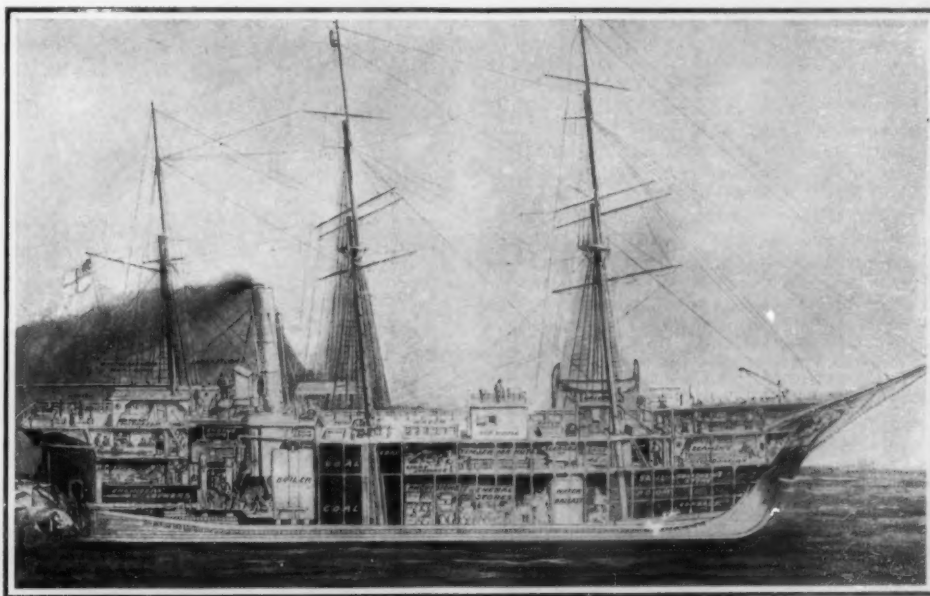
There is only one construction to be placed upon this passage. Oates knew that he could not live; he knew that, as a sick man, he was an impediment and the chances for the survival of the rest were better with himself out of the way. Bravely he stepped out of the tent and into the blizzard, never to be seen again.

In the last tent pitched by the party a final message, by Scott himself, was found. Written with the shadow of death upon him, its pathetic appeal has deeply moved the civilized world. We reprint it here from the columns of the New York Times:

Message to the Public.

"The causes of this disaster are not due to faulty organizations, but to misfortune in all the risks which had to be undertaken. One of the loss of pony transport in March, 1911, obliged me to start later than I had intended, and obliged the limits of stuff transported to be narrowed. The weather throughout the outward journey, and especially the long gale in 83 degrees south, stopped us. The soft snow in the lower reaches of the glacier again reduced the pace.

"We fought these untoward events with will and conquered, but it ate into our provisions reserve. Every detail of our food supplies, clothing and depots made on the interior ice-sheet and on that long stretch of 700 miles to the pole-and back worked out to perfection. The advance party would



By courtesy of *The Sphere*.

The "Terra Nova," prepared and provisioned for her journey.—A fore-and-aft section.

The numbers refer to the following: 1. Piano. 2. Pantry. 3. Instrument room. 4. Engineer's berth. 5. Evaporator for fresh water. 6. Ventilator. 7. Stove. 8. Biologist's locker. 9. Boatswain's store. 10. Carpenter's store. The motor, sledges and dogs are to be taken aboard at Lyttelton. The dogs will probably occupy the forecabin.

have returned to the glacier in fine form and with a surplus of food, but for the astonishing failure of the man whom we had least expected to fail. Seaman Edgar Evans was thought to be the strongest man of the party, and Beardmore Glacier is not difficult in fine weather. But on our return we did not get a single completely fine day. This, with a sick companion, enormously increased our anxieties. I have said elsewhere that we got into frightfully rough ice, and Edgar Evans received a concussion of the brain. He died a natural death, but left us a shaken party, with the season unduly advanced.

"But all the facts above enumerated were as nothing to the surprise which awaited us at the Barrier. I maintain that our arrangements for returning were quite adequate, and that no one in the world would have done better in the weather which we encountered at this time of the year. On the summit, in latitude 85 degrees to 86 degrees, we had minus twenty to minus thirty. On the Barrier, in latitude 82 degrees, 10,000 feet lower, we had minus thirty in the day and minus forty-seven at night pretty regularly, with a continuous headwind during our day marches.

"These circumstances came on very suddenly, and our wreck is certainly due to this sudden advent of severe weather, which does not seem to have any satisfactory cause.

"I do not think human beings ever came through such a month as we have come through, and we should have got through in spite of the weather, but for the sickening of a second companion, Capt. Oates, and a shortage of fuel in our depots, for which I cannot account, and, finally, but for the storm which has fallen on us within eleven miles of the depot at which we hoped to secure the final supplies. Surely misfortune could scarcely have exceeded this last blow!

"We arrived within eleven miles of our old One Ton Camp with fuel for one hot meal and food for two days. For four days we have been unable to leave the tent, the gale blowing about us. We are weak.

"Writing is difficult, but for my own sake I do not regret this journey, which has shown that Englishmen can endure hardships, help one another, and meet death with as great a fortitude as ever in the past. We took risks. We knew we took them. Things have come out against us, and, therefore, we have no cause for complaint, but bow to the will of Providence, determined still to do our best to the last.

"But if we have been willing to give our lives to this enterprise, which is for the honor of our country, I appeal to our countrymen to see that those who depend on us are properly cared for. Had we lived, I should have had a tale to tell of the hardihood, endurance, and courage of my companions, which would have stirred the heart of every Englishman.

"These rough notes and our dead bodies must tell the tale, but surely, surely, a great, rich country like ours will see that those who are dependent on us are properly provided for. (Signed) R. SCOTT.

"March 25th, 1912."

Campbell's Expedition and Its Relief.

An expedition under Lieut. W. A. L. Campbell, which had been sent to make geological investigations to the east of Cape Evans, also passed through perilous experiences, but returned safe and well. The "Terra Nova" had been unable to take the men off the year before on account of ice, and they were compelled to spend another winter in the Antarctic. In this party were Dr. Levick, Priestly, Abott, Browning, and Dickerson. A gallant attempt to relieve Lieut. Campbell was made in April, but the relief party was stopped by open water. Campbell and his companions were eventually rescued by the very searching party that found the body of Scott.

The escape of Lieut. Campbell and his northern party was miraculous. The men existed in absolute darkness except for the faint gleam of a seal blubber lamp. The supply of provisions was soon exhausted, and thenceforward they had to live entirely on seal meat and to endure extraordinary hardships.

The Condition of Amundsen and Scott Contrasted.

Amundsen and Scott must have passed each other in the Antarctic some time during Christmas week, 1911. Amundsen, rejoicing in his victory, was speeding away from the Pole with good fortune attending each day's journey. Scott, still hopeful, was forging stubbornly toward his goal, passing from the 86th to the 87th parallel and disposing his records and supplies so that when the last auxiliary detachment of his party started back under the guidance of Lieut. Evans, he would be ready for the final dash. Scott and Amundsen must have been near each other on December 28th, 1911, when they were a little more than 200 miles from the Pole and about 130 miles apart. At the rate of Amundsen's returning speed he could easily have crossed the intervening ice and snow and met Scott in less than five days' traveling.

Contrast Amundsen's return journey with that of Scott's. Here is Amundsen's account:

"On the return journey we had not a single day's rest. We did not even rest on Christmas day, but passed on day after day, through all weathers. There was little that was adventurous about the trip. But it was very hard work."

He suffered no privations, for he tells us:

"Of real hardships in the way of food on the pole journey there were none. Rather the reverse, for when my companions reached the ship, they were almost fat, and could not eat as much as when they started. The dogs, too, were fat, and that they had lived well during the last part of the journey was shown by the fact that they would hardly touch the seal meat which was lying in large quantities about the base camp."

Amundsen had full rations all the way, but in that climate full rations are a very different thing from having as much as a man can eat. "There seemed little limit to one's eating powers when doing a hard sledging journey," says Amundsen. "However, on the re-

turn journey we had not merely full rations, but as much as we could eat from the depots, after passing 70 degrees."

Although Scott himself, Shackleton and Amundsen had all made extensive researches in the vicinity of the South Pole, much still remains to be done.

The Scott Expedition, 1901 to 1904, discovered what is now known as King Edward VII. Land, extending east of the Great Barrier from 152 degrees to 157 degrees east longitude. Following the Great Barrier to 82 degrees 17 minutes south, Scott ascended the glacial covering to the overlying plateau, and after a journey of 300 miles reached an elevation of over 9,000 feet, a point in 77 degrees 39 minutes south and 147 degrees east longitude.

Shackleton's Expedition.

Shackleton's Expedition of 1907 to 1909 penetrated at the same place that Scott had previously entered, and proceeded up the western border of the ice field along the route which Scott had pursued. Shackleton thus reached a great glacier, named Beardmore Glacier, coming down from the highlands to the westward. In 127 days Shackleton and his parties traveled 1,755 miles, reaching on January 9th, 1909, a glacier-covered plateau about 11,000 feet above the ocean in 88 degrees 23 minutes south latitude at 162 degrees west longitude, within ninety-seven miles of the Pole. In extent and importance the discoveries made by Shackleton have not been surpassed by any other single expedition. Perhaps the most interesting discovery made by Scott was that coal existed in large quantities in the Antarctic continent—unmistakable evidence that a land now frigid and barren once bloomed in tropical luxuriance. While Shackleton's journey to the Pole was in progress, one party of the expedition climbed Mount Erebus and another reached the south magnetic pole and located it in 72 degrees 25 minutes south and 155 degrees 16 minutes east longitude, in a position forty miles distant from the point deduced by the first expedition of Scott.

Amundsen's Contribution to Polar Geography.

Despite all the haste with which he proceeded, Amundsen made important additions to our knowledge of the Antarctic continent, particularly in that sector of the earth's surface extending from the South Pole to the eightieth degree parallel of latitude, between the meridians 160 degrees and 180 degrees west of Greenwich. He rather confirmed the view that the Pacific Ocean must be bounded on the south by a coast of the "Pacific type," the main characteristic of which is that the trend is determined by mountain ranges running parallel to the shore. The type is well exemplified in New Zealand on one side and by the Andes of South America on the other.

Amundsen's Antarctic venture came as a great surprise to the world. He left Norway in June, 1910, in the "Fram," seemingly with the intention of sailing around Cape Horn and through the Pacific Ocean and then Bering Sea into the Arctic Ocean. Upon rounding Cape Horn, however, he sailed to the westward across the South Pacific and made a landing at Whale Bay on the ice sheet covering Ross Sea. This place is in King Edward VII. Land, near the eastern end of the ice front and opposite that point on Ross Sea from which Scott and Shackleton made their successful entrances into the interior. In less than a month the southbound expedition had cleared that vast plain of floating ice which flows down from the great mountains of the interior and covers the southern part of Ross Sea, throughout an area of 20,000 square miles, with an ice sheet approximately 800 feet in thickness. By a series of wonderful marches Amundsen reached the South Pole on December 16th, 1911. He followed the 164th meridian (west) to a mountain range in about 85 degrees south latitude. Here his party crossed Devil's Glacier, between mountain peaks about 15,000 feet high. The glacier led to the South Pole plateau, about 10,500 feet elevation, entirely ice covered. The route developed was new and independent.

Naturally one cannot help comparing Scott with Amundsen. There was a marked difference in their immediate motives. Unquestionably the attainment of the South Pole was the primary object of Amundsen's undertaking in the Antarctic; though, as we have previously pointed out editorially, this broad-minded leader did not consult his own taste in the matter. He made a deliberate concession to popular ideals for the purpose of winning financial support toward an enterprise that did not, in itself, strongly appeal to the public—namely, his proposed five years' drift across the North Polar basin. Similar devious means to philosophic ends have often been resorted to by scientific men.

Not for many months will we learn anything really definite of the scientific results attained by the Scott expedition that terminated so tragically. Enough evidence is at hand to warrant us in stating that one of the auxiliary parties, at least, conducted researches that are invaluable, and that will illuminate the dark subjects of Antarctic meteorology, geology, oceanog-

raphy, geography, and biology. Indeed, there is every reason to believe that from a scientific point of view the Scott expedition was even more brilliantly successful than that led by Shackleton.

One-man Broadside Control

V ICE-ADMIRAL SIR PERCY SCOTT, the famous gunnery expert, has invented, and the British Admiralty, after long and severe trial, has adopted an apparatus for improving naval gunnery, by which astonishing results have been attained. The gear, known as a "fire director," was fitted in the super-dreadnought "Thunderer," armed with ten 13.5-inch guns, and this vessel carried out a series of comparative tests with a sister ship, the "Orion," fitted with the "fire control" system previously in general use. Firing in rough weather at a range of 10,000 yards, at an ordinary battle-practice target (90 feet long and 30 feet high) the most extraordinary results were obtained, the "Thunderer" making four times as many hits as the "Orion," the average of the former vessel being eighty per cent of hits to rounds fired. The tests were carried out in the presence of a large committee of naval officers, including Rear-Admiral Peirse, an ex-Inspector of Target Practice; Rear-Admiral Browning, the present Inspector, and a large staff of specially selected naval gunnery experts. As a result of the tests it has been decided to fit the apparatus to all ships of the dreadnought type at an estimated cost of \$2,500,000, while the inventor of the system has been honored with a baronetcy.

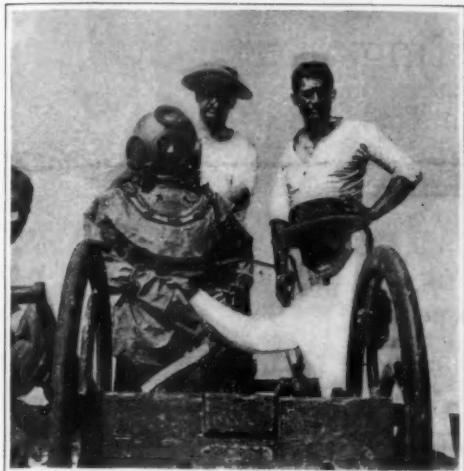
The greatest precautions have been taken by the British Admiralty to prevent the details of the new system from being made public, and this is very significant when it is recalled that all previous inventions of Sir Percy Scott have been patented, and, therefore, published. In its essential features, however, the "fire director" resembles a similar apparatus which was in use in the muzzle-loading era, when many of the battleships which were built carried from six to a dozen heavy guns of the same caliber. This was invented by Capt. Moorsom, of the British Navy, and, to quote from a work on "Naval Gunnery," by Capt. Garbett, was an apparatus "by means of which the bearing and distance of the target and the heel of the firing ship were all determined, and the guns laid accordingly; it was generally fixed on the upper deck, over the center main-deck gun, or other convenient position, and the signal or order to fire was given by the officer attending it as soon as he found the object coming on with his sights." Many scientific and mechanical advances have, of course, been made since this apparatus was invented in 1850. Instead of the officer in charge of the "director" passing along directions to the captains of the guns by word of mouth, he directs the guns himself electrically under Admiral Scott's system; and instead of giving "an order or signal to fire," he fires himself by pressing a button and completing a circuit. All that the guns' crews have to do is to clean out the guns after each round and to load them for the next.

It has been stated that the "Thunderer," while undergoing the tests, fired several concentrated and simultaneous broadsides. It is understood, however, that the Scott apparatus is such that there is a momentary interval of time between the firing of each pair of turret guns, so that the structure of the ship is not called upon to bear the absolutely simultaneous discharge of ten guns, each with a muzzle-energy of 69,000 foot-tons.

The fire-director is situated in an elevated position on the foremast, as in the case of the fire control apparatus. The obvious drawback to the system is that if one shot misses the whole must miss; but on the other hand, if one strikes home nine others, or as many others as there may be on the broadside, strike home as well, and the ship has not yet been built which could stand the attack of ten 1,250-pound shells simultaneously. The thorough tests carried out by the British Admiralty show that four out of every five broadsides can be depended on to reach the target.

The Current Supplement

IN the current issue, No. 1938, of the SUPPLEMENT, R. H. Reid discusses the advantages of the heavy-oil engine for marine service.—H. T. Kalmus points out the important relation of research to the conservation of our natural resources.—L. C. Talmage, in an illustrated article, describes the extensive harbor developments of Texas City.—Suspicion has become centered on the stable fly as the chief carrier of infantile paralysis, according to a paper by Mr. C. T. Brues.—The snares and pitfalls of "beauty doctoring" are laid bare by Dr. H. Greeley.—This issue brings an important article by H. F. Smith on the chemical and mechanical aspects of the manufacture of producer gas.—Capt. W. I. Chambers call our attention to the importance of a National Aerodynamic Laboratory for the United States.—Spices are not merely useless luxuries or even mere appetite-stimulants—they have antiseptic properties, as has been shown by Hoffman and Evans.



Ready to descend in a diving helmet.

Painting the Wonders Under the Sea An Artist Who Works Under Water

By Charles M. Carroll

MR. Z. H. PRITCHARD, an artist now working in California, devotes his life to painting pictures under water. He holds that it is impossible to catch the colors and what might be called the atmosphere of submarine scenery by any method of observation from the surface. Even when the disturbing effect of the broken surface of the water is eliminated by using a glass-bottomed boat or tube, everything appears unnatural and distorted to the beholder. Mr. Pritchard goes down to the bottom of the ocean wearing a diver's helmet, and makes sketches on waterproof paper with waterproof crayons. The paintings are then completed in his studio.

Mr. Pritchard is an Englishman by birth. When still a boy he made for himself a pair of water-tight goggles, similar to those worn by the famous pearl divers of the South Seas. These goggles are merely bits of cow horn cut and shaped to fit the eyes. They allow a small space of air between the eyes and the water so that one can see very well. With these goggles the young man studied the "landscapes" under water with a clear vision. His imagination had been fired by Jules Verne's "Twenty Thousand Leagues Under the Sea," but he speedily discovered that it was impossible to shoot birds from the sea bottom, as Verne asserted, as the sky is rarely glimpsed by the diver, and then only by looking directly upward, for at a moderate angle the surface becomes a gigantic silver mirror, reflecting the silent cities of coral and the lone, grotesque figure of the diver.

Mr. Pritchard became a decorator in England, and a very successful one. He had preserved a few sketches made from memory of the scenes under water, and showed them to some critics; but when his fellow artists ridiculed his work, he became discouraged.

About this time his health failed, and his doctors ordered him to go to Egypt. Instead, he went to



Mr. Pritchard ready for work when using the "diver's goggles," the latter shown suspended about his neck.



Coral-eating chaetodonts, off Tahiti.



Painting showing sand heaps on the bed of the sea.

Tahiti, one of the South Sea Islands, where he learned the most wonderful coral formations in the world were to be found. Arrived there, he decided to take up actively the work of painting the under-water world.

His process at first was comparatively crude. He would go out in his boat with his helpers, find his country with a glass-bottomed box and descend by means of weights hooked to his waist. Then he would make mental notes of the rock or coral formations, ascend, and paint them. But this method proved unsatisfactory. He wanted to make actual sketches under the water.

After seemingly endless experimenting he discovered a way of making waterproof paper by soaking extra heavy drawing paper in coconut oil and draining off the surplus. This, after drying, proved to be a good working surface. Mr. Pritchard fastened it to plate glass, which served as his drawing board, by means of surgeon's tape, in order that the water might not ooze under the paper and wrinkle it. He used Raffaeli crayons, semi-solid oil points, which are especially adapted to submarine painting.

After putting on his diving dress and goggles, he would take a good breath and lower himself down in the water, using a heavy lump of coral attached to his belt by means of a hook to keep him down. Arrived at the bottom, he would sketch from 30 to 45 seconds, then unfasten the piece of coral and ascend for breath. The coral was then drawn up by means of a rope for another descent. In this way he was able to complete his sketch after a number of descents. Nowadays he uses a diver's helmet, and is able to complete his sketch in one descent.

Thus he works, clad in his clumsy diving suit, sitting on a rock and surrounded by the wonderful tropical fish. Of these fish Mr. Pritchard is enthusiastic. He tells of many varieties, from some so tiny that many of them together can be carried on his thumb nail, to huge monsters that drift silently and ominously past. There are the bizarre coral-eating chaetodonts, that

(Concluded on page 185.)



Coral formations in the South Sea, the most wonderful in the world.



A rocky gorge in 40 feet of water, off the west coast of Scotland.



A submarine "grove" of polyps, from a landscape study under water.

Inventions New and Interesting

Simple Patent Law ; Patent Office News ; Notes on Trademarks

Safety Lathe Dog

THE accompanying engraving shows two forms of lathe dogs, one the common form and another the improved form adapted to avoid danger of injury to the operator of the lathe. In the common form of lathe dog the set screw is disposed on the opposite side of the eye from the arm that engages the face plate. With this construction there is always the danger to the operator of being struck by the sharp edges of the head of the set screw or by the projecting arm of the dog. In the improved form of lathe dog, this danger is avoided by having the arm curved around toward the set screw so as to serve as a shield for it. Thus it will prevent the sleeve or clothing of an operator from being caught by the set screw and even if the operator's hand is struck by the arm, the blow will be more in the nature of a push, owing to the curved form of the arm.

Waste Steam Detector

A GREAT many firemen on locomotives labor under the impression that the hotter they keep their fires the better firemen they are. Hence they force their steam up to such a pressure as to keep the safety valve constantly "popping" or "blowing off," not realizing that the steam which pours out represents an actual waste of water and fuel. It is calculated that it takes a quarter of a pound of coal to produce the amount of steam that escapes through a valve three and a half inches in diameter for each second of such escapement. This amounts to fifteen pounds of coal per minute or approximately half a ton of coal per hour. With larger safety valves the weight will be proportionately greater.

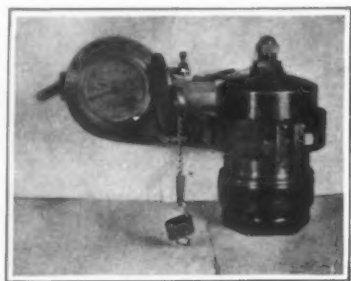
Heretofore there has been no way of determining how much fuel is wasted in a given time in the operation of an engine, but an inventor has recently designed a device which keeps a record of the time during which the safety valve is blowing off. The recording device is kept locked so that it cannot be tampered with, and at the end of a run an inspector can unlock the device and determine the exact number of minutes during which the steam was blowing off. The inventor claims that from experiments so far made, by the use of his device, a waste of an average of over two tons of coal has been saved in a ten-ton run.

The device is attached to the casing of the safety valve, as shown in the engraving. It consists of a clock mechanism with two concentric, graduated circles, one for the minute hand and one for the hour hand. The circle for the minute hand is not only divided into minutes, but it is also marked with the equivalent in the pounds of coal of the steam wasted during the corresponding periods of time. Similarly the circle for the hour hand is marked off with the equivalent loss in tons of coal. A lever mounted on the device carries, at one end, a brush which is adapted to engage the escape-wheel of the clock mechanism, while a broad blade on the other end rests on the perforated top of the safety valve casing. When the valve blows off, the steam hits this blade, drawing the brush out of contact with the escape-wheel and permitting the clock mechanism to run.

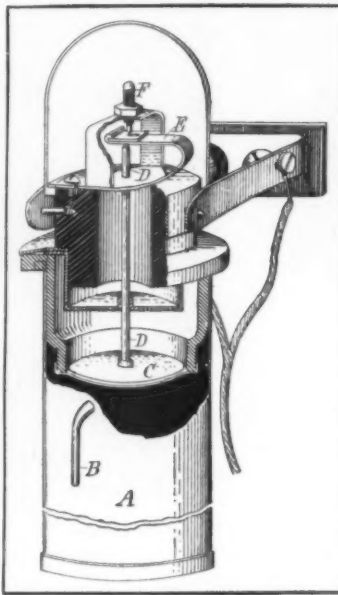
At the start of a run the instructor sets the clock hand to 12 o'clock



Safety lathe dog.



Device for recording the "poppings" of a safety valve.



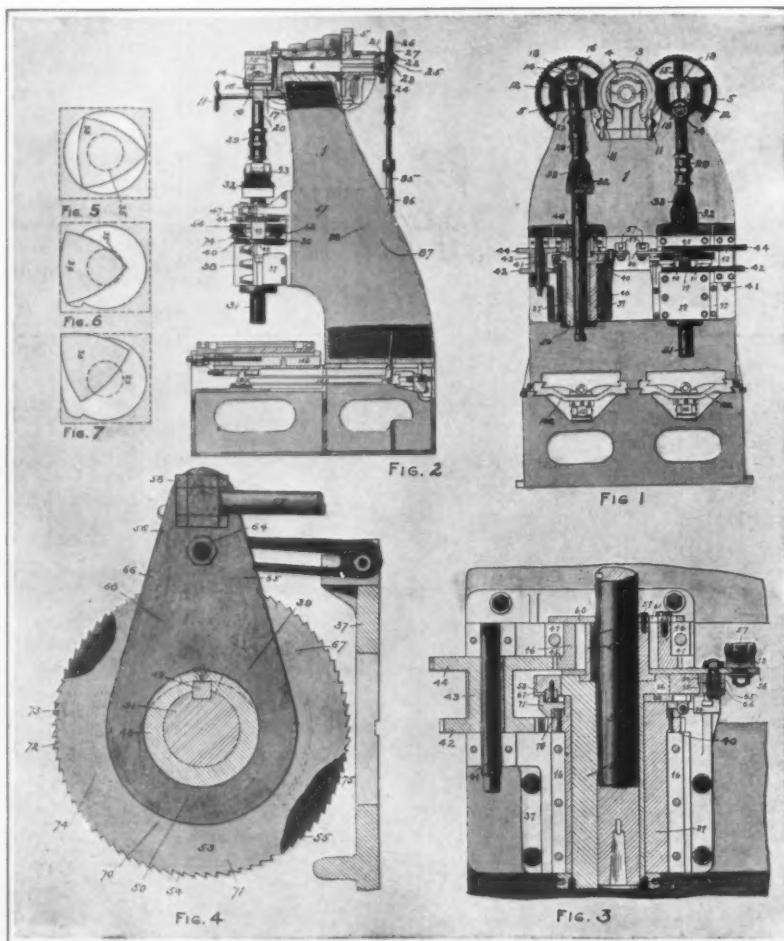
Fire alarm operated by variation of temperature.

and then locks the casing of the clock. At the end of the locomotive run he can determine at a glance the length of time that the safety valve had blown off during the run, and also the equivalent amount of coal that has been wasted by the fireman.

A Novel Coaster

A CORRESPONDENT writes that in his city they have smooth asphalt

streets and many hills adapted for coasting. Recently the boys have produced, in large numbers, home-made coasters consisting of narrow boards about 4 feet by 2 feet by 2 feet to 3 feet, to the under side of which near each end are fixed one pair of the rollers from a roller skate. On the front of this bar is secured a small packing box extending up about ten or twelve inches, and on top of this is secured a bar which projects laterally at



This machine has been designed to meet the great demand for turning out automobile transmission gears quickly and cheaply. There is a great demand in factories for a means whereby square, hexagonal, or other polygonal holes may be cut in the gears automatically, rapidly and with accuracy.

both sides to form a handle. By this, when momentum is once acquired, the odd vehicle is stabilized so it will maintain its upright position just like a bicycle. Naturally the box obstructs the view of the roadway, and it is believed that the idea can be developed into a neat attractive device that can be cheaply produced and should prove a popular and profitable toy.

An Automatic Fire Alarm

THE earliest automatic fire alarms are virtually thermometers arranged to close an electric circuit when a dangerously high temperature was reached. The objection to this form of alarm lies in the fact that it is liable to be operated where there is no fire, as by an accumulation of heat in some badly ventilated spot, or again, it may fail to operate where there is a fire until the fire has gained considerable headway, merely because the temperature at the particular point where the automatic device is located may not happen to rise to the point for which the device was set. The apparatus shown in the accompanying drawing overcomes this difficulty. It operates to close an electric circuit when there is a sudden rise of heat. In other words, it is not the degree but the variation of temperature that affects the apparatus, provided the variation is sudden. The device consists of a metallic chamber A, which forms an air reservoir. In the side of this reservoir there is a small pipe B, which serves as an air vent. Stretched across the upper end of the air reservoir is a diaphragm C, which carries a stem D that bears against the leaf spring E, forming one terminal of the electric alarm circuit. The other

terminal consists of the platinum-pointed screw F. Now in case of a sudden rise of temperature, the air in the chamber A is rapidly expanded so that it raises the terminal E into contact with the terminal F, closing the electric alarm circuit. This may be a gong or an automatic sprinkling device. In case of a gradual rise of temperature, the expanding air in the chamber A escapes fast enough through the tube B to prevent flexing the diaphragm C. The apparatus is so sensitive that the heat of the hands when applied on the chamber A will cause the alarm to ring, and yet if the device be located above a kitchen range, the heat of the range will not cause the alarm to be set off. However, if a piece of newspaper be set on fire on top of the range, the alarm will immediately be sounded.

Recent Improvements in Machine Tools—III

THE recent enormous activity in the automobile industry has given rise to a great demand for transmission gears to be used on automobiles. There has consequently become a great demand in factories where there is a large output for this industry, for a means whereby square, hexagonal, octagonal or other polygonal holes may be cut in the gears, automatically, rapidly and with accuracy.

A. H. Marsh of Jackson, Mich., has recently patented a machine which is adapted to cut such holes in gears, plates or other work.

As seen in Fig. 1, the machine is a duplex one, the same driving mechanism, including the cone pulley 3, pinion 4 and gears 5, serving to operate the two shafts 6. The

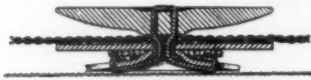
(Continued on page 185.)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

FASTENER FOR BUTTONS AND OTHER ARTICLES.—O. D. BELL, 217 Fenimore St., Brooklyn, N. Y. The present invention is a fastener of the friction or tension type, and involves a cord having looped engagement with



BUTTON FASTENER.

the articles to be fastened and disks for frictionally gripping the ends of the cord. The device is especially intended for use in fastening buttons to garments made of fur or any heavy fabric, to which it may be applied without sewing.

SWEATER OR LIKE GARMENT.—B. I. CAMPE, care of Hecht & Campe, 377 Broadway, N. Y., N. Y. With sweaters having soft collars, as specified for the wearing of links engaging collar flaps, the links are liable to become disconnected from one or both collar flaps, and the collar has a tendency to curl or creep upward, and moreover, when ties are worn with the garment, they are usually four-in-hands, or ties similar to these, and the knot of the tie frequently sags, putting a strain on the link, tending to pull the buttons of the links through the buttonholes. The invention overcomes all these drawbacks.

COMB AND BARRETTE.—J. A. BURLANDO, 3674 White Plains Ave., Williamsbridge, Bronx, N. Y. This inventor provides a co-operating comb and barrette, the latter being adapted to be held on the comb after the comb has been positioned on the head. The use of the co-operating comb and barrette prevents loss of the barrette or the comb since the parts are held in engagement with each other, and also with the person's hair.

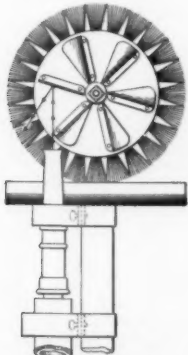
Electrical Devices.

SIGN AND INDICATOR.—P. FICCIO, 1015 Franklin St., Tampa, Fla. In order to indicate the direction in which a vehicle is about to turn, Mr. Ficcio has devised a sign or indicator which may be attached to the rear of a vehicle and which may be operated mechanically to project into view, a slide bearing a legend or word showing the direction the vehicle is about to take.

ELECTRIC BELL.—A. L'ONGEN, care of Edwards & Co., 140th and Exterior Sts., Bronx, N. Y., N. Y. The object here is to so construct the parts in respect to the cover or casing that the cover will more effectually exclude dust, dirt and insects from the parts. By pivoting the hammer at a point closely adjacent the casing side wall through which the hammer extends, the opening in the wall may be made only slightly larger than the hammer, as the hammer will move an almost negligible distance at this point during its oscillation.

Of General Interest.

FOUNTAIN BRUSH.—R. VERBEKE, Tryon, N. C. The object here is to provide a rotary brush with cups or buckets at its sides, which is mounted for rotating on a bracket having a clamp by which a nozzle of a standard hose may be secured to the bracket for directing water against the cups or buckets to rotate the brush, these being so proportioned that the water will be directed by the cups or buckets



FOUNTAIN BRUSH.

to the brush, so that the force of the water will not only rotate the brush, but the water will be rotated by the cups or buckets to the brush to continue to supply the brush with fresh water.

COMBINED FIREARM AND SWORD.—J. CHUCKI, 312 So. Main St., Shenandoah, Pa. This invention provides an instrument having co-acting members which may be used simultaneously or independently for offensive and defensive warfare. It also provides a structure on the grip of a sword and so arranges the

same that the sword and the firearm may be used independently, and that the end of the sword and one end of the guard may be used as sights for the firearm.

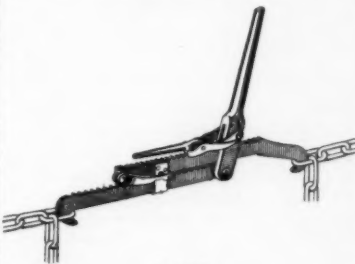
BRUSH.—A. G. CARLING, 133 W. 64th St., Manhattan, N. Y., N. Y. This brush is provided with bristles for scrubbing and cleaning the hands and nails, and is also provided with a scraper whereby oil and grease may be effectually removed and thus permit effective operation of the bristles in thoroughly cleaning the skin and nails of the hand.

TICKET HOLDER.—H. P. IPSEN, 1436 Crotona Park, E. Bronx, N. Y., N. Y. This invention relates to ticket holders, and has for an object to provide a simple, inexpensive and efficient device which will inclose the tickets for protecting the same, but which may be readily ejected, one ticket at a time, whenever desired.

SECTIONAL DAM AND FLUME.—C. E. HOLMES, 370 River Front, Beaumont, Tex. This invention provides a dam and flume more especially designed for use in brooks and other small water-ways for damming the water and for conducting it by the flume to a turbine or other motor, and arranged to permit of conveniently placing the dam in position in the water-way and to support the flume.

Hardware and Tools.

CLAMP.—C. F. SMITH and J. ROBERTSON, Dutchess Junction, N. Y. The several objects of this invention are attained by disposing two ratchet bars one above the other with a pinion connection between the two bars, to automatically hold the same in position, and pivot to one of the bars a lever having a



CLAMP.

ratchet thereon adapted to fit one of the bars upon the other, to be held by the first-mentioned ratchet. The invention further disposes on the hook ends of each of the bars a removable facing plate to change the chain clamp into a carpenter's clamp.

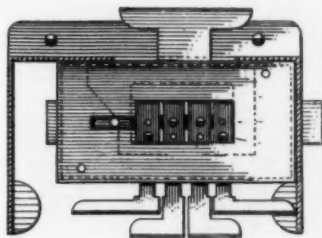
PARALLEL PROTRACTOR.—C. P. EAGER, care of U. S. Surveyor General's Office, Reno, Nev. This invention furnishes improved means whereby any angle may be quickly and accurately found. It permits the protractor



PARALLEL PROTRACTOR.

to be adjusted for forming parallel extensions whereby lines may be drawn several times the length of the protractor while remaining in its original position. It engages the board or paper on which the device is mounted, associated with movable means and a measuring indicator whereby the device may be swung around a given point and caused to occupy any desired angle to its original position, such angle being disclosed on the indicator.

KEYLESS LOCK.—S. BROWN, 3122 W. North Ave., Chicago, Ill. The lock is adaptable to a door or gate of an office building where it is desirable to have some means for readily opening the gate without the necessity of in-



KEYLESS LOCK.

serting a key or working a combination. The lock has a series of finger keys so arranged that by grasping them in a certain way, the bolt will be actuated, but grasping them in any other way, will lock the bolt and prevent its actuation.

SAFETY RAZOR.—L. KALINA, care of Midget Mfg. Co., 178 Center St., N. Y., N. Y. This razor is adapted to be constructed of a size to permit the use of the same as a cuff button, and while the device may be described more particularly with relation to its function as a safety razor, it is to be understood that one of a pair of these combined safety razors and cuff buttons may be made of a size and material adapted to be carried in the cuff, the

other member of the pair being made to simulate the cuff button constructed as a razor.

COMBINATION DENTAL AND SURGICAL TOOL.—H. A. PARR, 500 Fifth Ave., Manhattan, N. Y., N. Y. This improvement provides a tool more especially designed for cutting superfluous flesh, such, for instance, as grows over the wisdom tooth or other part in the mouth, and for readily sifting or cutting cap crowns preparatory to removing the same.

REVELED DRILL SOCKET.—A. J. BOONE, care of E. L. Duden, 165 Broadway, New York, N. Y. The invention provides an improved structure designed to receive the shanks of drills regardless of whether or not the same have tangs associated therewith. A further provision is that of a tapering socket formed square or irregular in cross-section for receiving a correspondingly shaped shank.

Household Utilities.

STOVEPIPE JOINT.—C. B. SISLER and J. M. DEVENPORT, Timberville, Miss. The invention provides a joint to permit of the firm coupling of the pipe sections which will be particularly advantageous in the case of stovepipes running horizontally, the joint in such a case serving to make a self-supporting connection between the pipe sections that will prevent sagging or accidental disconnection of the sections.

APPARATUS FOR ROLLING TOWELS, NAPKINS, AND THE LIKE.—P. G. MERRITT, 1931 Berlin St., New Orleans, La. The purpose here is to produce rolls containing a plurality of separate towels or napkins so constructed that they may be delivered or dispensed one at a time, so that the withdrawal of one will result in the partial withdrawal of the next adjacent one in the roll, leaving a free end projecting from the dispenser.

Prime Movers and Their Accessories.

ENGINE FEED WATER REGULATOR.—O. C. MOORE, Morrow, Ohio. The present invention is related with patents filed by Mr. Moore bearing Serial No. 599,175 and Serial No. 599,176, respectively. The invention provides simple and efficient means for regulating the length of stroke of a reciprocating pump connected with the water supply to conform with the working conditions of engine boilers, and friction of the moving parts in the regulating mechanism is eliminated.

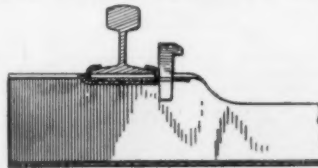
INTERNAL COMBUSTION ENGINE.—L. E. WOODSEND, care of Western Ice Machine Co., 128 W. 2nd St. South, Salt Lake City, Utah. This invention is adapted to use distillate and crude oil in obtaining power; and it more particularly relates to an improved firing head. An object is to provide an engine with an improved firing head, which will vaporize and ignite crude oil or distillate, in a simple and efficient manner, without danger of clogging.

CRANKING DEVICE.—R. D. CLEMSON, Middletown, N. Y. This device is arranged to utilize the power of a wound-up spring of a spring motor to do the cranking, to cause the engine after being started to wind up the spring of the motor and to automatically disconnect the cranking device from the engine shaft to permit the engine to run free of the cranking device and to have said device ready for restarting the engine when desired.

Railways and Their Accessories.

TRIPLE VALVE.—E. K. HUTCHINSON, 1705 So. 1st St., San Jose, Cal. This invention provides a triple valve with means to retard the release of the brakes, and the filling of the auxiliary reservoirs at the front of long trains, so that on the rear cars the brakes will in all cases be released and the reservoirs will be recharged on or before the brakes are released and the reservoirs are recharged at the front of the train.

METALLIC RAILROAD TIE.—H. BOYD, care of Thomas Iron Co., Hokendauqua, Pa. Mr. Boyd's invention has for its object the provision of a simple economical tie made of



METALLIC RAILROAD-TIE.

metal and having a maximum of strength for the material used. The construction is such as to provide special strength at the seat of the rail, and a fastening device is provided which permits of applying or releasing the rail quickly and of locking the rail firmly to the tie.

RAIL ANCHOR.—J. W. ENRIGHT, 862 Tchoupitoulas St., New Orleans, La. The invention relates to a means for securing railway rails in place and particularly to securing rails from creeping and lateral displacement. This result is obtained by providing a baseplate with an overlying flange, between which and the base of the rail a wedge is driven.

RAILROAD TIE.—C. YEADICKE, care of F. J. & J. T. Burns, Suite 7, Trust Bank Bldg., Kankakee, Ill. The invention provides an improved cross tie for railroad rails which is

made of metal and for this reason has superior qualities of strength and endurance. The object of this invention is to improve the form and design of metallic ties so as to cheapen their construction and make them more stable and efficient in use.

Pertaining to Recreation.

POOL AND BILLIARD TABLE.—G. S. VAN DE WATER, care of Wallie Dorr Co., 16 Reade St., New York, N. Y. This invention relates



POOL AND BILLIARD TABLE.

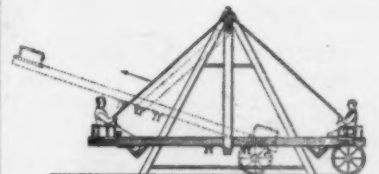
generally to pool and billiard tables and more particularly is directed to an improved cushion construction adapted to occupy different positions whereby the same table is convertible into a pool or billiard table. The principal object is to provide a cushion for use with pool or billiard tables, the said cushion being removably held in position, the improvement residing in the shape of the cushion whereby it may occupy different positions to close the pockets or leave them open, thereby providing either a pool or a billiard table. The illustration is a top plan view which pictures the cushions in position to form a pool table.

Pertaining to Vehicles.

SPRING WHEEL.—V. E. LANE, 288 Park St., Detroit, Mich. This invention relates to resilient wheels which are commonly employed on pleasure and commercial vehicles, and among the objects aimed at in the present improvement, is to construct a wheel neat in appearance, compact and practically dustproof with respect to movable parts.

TRACE HITCH.—T. J. JOHNSON, Box 36, Allentown, Pa., and J. C. LUCAS, Allentown, Pa. This invention provides a device adjustable to accommodate traces of various thicknesses; to increase the range of adjustment of the length of the traces; and to facilitate the operation of fastening the traces in operative position.

VEHICLE SWING.—O. ZIMMERMAN, 6815 South Park Ave., Los Angeles, Cal. The object of the inventor is to provide a mechanical swing arranged to provide an exhilarating exercise and considerable amusement to young and old using the swing, to insure safety in the



VEHICLE SWING.

use of the vehicle swing and to guard against a tendency of producing dizziness of the user. For the purpose named, use is made of a suspended link pivotally supporting at its lower end a supporting frame provided at one end with wheels and seats, the wheels being adapted to travel on the ground, on the floor, or rails or other suitable support.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We are prepared to render opinions as to validity or infringement of patents, or with regard to conflicts arising in trade-mark and unfair competition matters.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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Patent Attorneys,
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Branch Office:
625 F Street, N. W.,
Washington, D. C.



G. V. Electric Trucks

With Underslung Battery

Below we illustrate a 3½-ton G. V. Truck in the service of the Metropolitan Engineering Company, Brooklyn, New York. This truck has a rated mileage of 40 miles per charge, but that is not maximum, and as it is provided with an underslung battery, the rated mileage can easily be doubled.



A fresh battery can be substituted by the underslung method in from 5 to 10 minutes. The truck is driven over a pit, the old battery dropped and the new one lifted into place, usually by hydraulic power. Several prominent firms, among them a department store, a wholesale provision house, not to mention numerous Central Stations, are using the underslung battery with unqualified success.

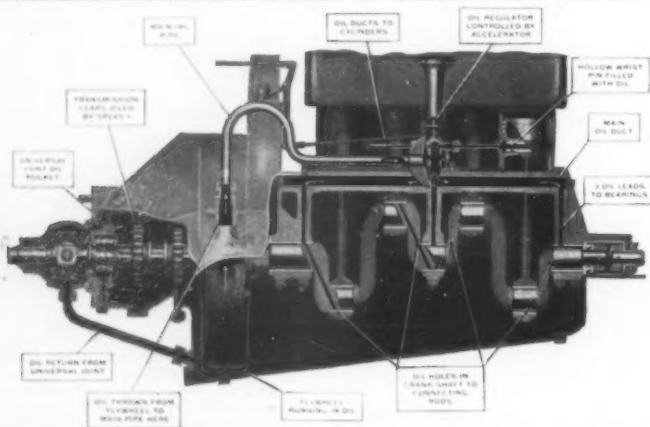
Before you buy Motor Trucks, consult the world's largest manufacturer of Electric Trucks. One with a product standardized five years ago; one with ample resources and an engineering corps which can meet yours on its own level.

Six capacities, 750 lbs. to 5-tons. Catalogue 101 and comparative cost figures on request.

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Sure--Simple--Saving

is this Unique Oiling System

Oil is cheaper than parts.

So the Hupmobile engineers have devised an ingenious system, whereby oil is positively fed to every part and point where it is needed.

The Hupmobile system, though force-feed, escapes the complication of the pump, because the motor flywheel supplies the pressure; and the uncertainty of the splash, because tubes and ducts of ample size carry the oil to bearings, gears and moving surfaces.

The flywheel, running in oil, throws the oil up into a copper tube, which carries it to the regulator and distributing points.

The oil is conducted to the main crankshaft bearing by three tubes; and by ducts drilled in the crankshaft itself, to the crankpin bearings.

Spray from these, as the shaft revolves, lubricates the camshaft, and the cylinders under ordinary

conditions; but as an added precaution, separate leads conduct oil directly to the cylinders.

So much for efficiency. Now we come to economy.

The flywheel casts some oil into the transmission gear case, and the transmission gears splash it through a pocket and tube to the universal joint.

Thus but one kind of lubricant, instead of three, is required for motor, transmission and universal.

The oil returns to the crankcase basin, to be circulated again; but the passage of sediment or grit is prevented by filtering screens; and the flywheel is surrounded by a pan, with perforations so high that sediment cannot be drawn up.

A regulator connected with the throttle controls the oil, so that the proper quantity is automatically used at all motor speeds.

Engineering ingenuity has not devised a system of lubrication more simple or efficient or economical; yet this is the system of the 1913 Hupmobile.

This detail is typical of the high-class construction found throughout the Hupmobile.

It is another bit of design that justifies our belief that the Hupmobile is, in its class, the best car in the world.

Hupmobile



Hupmobile "32" Touring Car, fully equipped, \$975

HUPP MOTOR CAR CO.

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"32" 6-pass. Touring Car, fully eq., \$1175 (a.k. Detroit)

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The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

Where the Motor Bus Beats the Trolley

By J. R. Eustis

WHILE the United States leads the world in the use of motor trucks, having more in service than any other two countries combined, there is one type, the motor omnibus, in which England, France and Germany lead this country by a wide margin. It is hard, in fact, for us to really appreciate the extent of the motor bus service now provided in the cities of London, Berlin, and Paris.

The largest company operating in London, for example, now has over 1,500 motor omnibuses in service. This is the London General Omnibus Company, and its installation of motor vehicles is the largest in the world. This company formerly owned 18,000 horses and over 2,000 horse-drawn buses, but these have now been entirely discarded.

This company carried in the past year 216,300,000 passengers, or only about 25 per cent less than the 287,190,629 passengers who rode in the New York subway during the year ending last December. The lack of a comprehensive system of surface electric cars in London, of course favors the use of motor omnibuses.

That the motor omnibus has decided advantages over the street car, and will largely displace the latter, is indicated by figures now available for both the London County Council and the London General Omnibus Company. The former, operating tram lines under a \$90,000,000 capitalization, obtains a route mileage per car of 139 miles per day, while the latter, with \$11,230,000 capital, gets 170 miles per day. For February of this year the bus companies' business showed an increase over the corresponding period of 1911 of 21 per cent, while the tram lines gained only 6 per cent. The motor omnibuses are, therefore, not only proving more popular with the traveling public, but evidently return larger dividends.

has been revolutionized, and in place of immense stables, we have a fine garage, which has saved us indirectly, half a million dollars in real estate alone.

We had a stable 200 feet wide fronting on East Fifty-fifth Street, and back of it three wagon yards and some other buildings, used just for our horse equipment. We tore down half of the stable, converting the rest of it to other uses, and built on the ground so released a big bottling plant. In one of the wagon yards we built a garage for our trucks, 85 by 100 feet, and this is all the ground necessary to house 100 trucks, because we only need five stories even for that. The long and short of it was, we were wasting about twenty-eight city lots worth from \$15,000 to \$20,000 each. And that isn't all the money we saved. In addition, the saving of from 18 cents to 20 cents per barrel on beer delivered, plus the saving on drivers, foots up to between \$60,000 and \$75,000 per year.

We haven't completed nearly all our plans yet. Inside of another year, we shall establish four depots in Greater New York, delivering the beer from the brewery to the depot with heavy trucks and distributing it from these centers with lighter power vehicles. By this method, we expect to operate electric trucks exclusively, as we believe electricity is going to supplant other forms of power in the industrial world. Year by year we drive more machinery and appliances in our brewery with electricity, and there are good reasons for doing this. Things reached a point where it cost us 96 cents per day to feed and care for each horse in our service. We knew we had to find a solution for that expense or go out of business and that principle applies to other things as well. Two men with salaries aggregating \$38 per week, care for all our motor trucks, so you see the difference.

Cost of Gasoline Truck Service

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of JANUARY 18th, we note with considerable interest the article by Mr. H. W. Perry entitled "Teams and Motor Trucks Compared."

We beg to take exception to the figures he gives, as he assumes that full loads are always hauled both ways, which is very rarely the case. It is very seldom that full loads are carried half the distance the truck travels.

You can readily realize that if the truck starts out with a load of merchandise and begins making deliveries, by the time it reaches its farthest point it will be empty and will return in that condition. With contractors full loads are often carried to destination and then the truck returns empty. With breweries and allied industries full loads are often taken to one point and a load of "empties" brought back, and these are the people that generally have the greatest ton mileage.

So you will see from this that it is not possible to figure out ton mileage unless the exact conditions are known. This term is often used, and very seldom is it used correctly. We consider the cost per mile a much more reliable figure.

We also notice "Cost Estimates of Horse and Motor Trucks" by Mr. John Ritchie, Jr. Our experience is only with a 5-ton gasoline truck, but the writer's experience has been with all the different sized machines from 2 tons to 10 tons capacity, and he has invariably found that a gasoline truck is much cheaper to operate at, say, over 24 miles a day, than is the electric of similar capacity working under the same conditions.

Mr. Ritchie refers to the tests made by

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List of Chapters

Chapter I—The Trade Mark as a Business Asset. Chapter II—The Federal Trade Mark Law. (Classification of Merchandise). Chapter III—Analysis of the Requirements of Registration. Chapter IV—The Elements of a Good Trade Mark. Chapter V—Trade Mark Protection. Chapter VI—Practical Information which should be furnished the Trade Mark Attorney.

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the Massachusetts Institute of Technology. We have the Bulletin No. 2 giving these tests, and averaging the figures they give in reference to five-ton trucks, and using the cost for current given us by the New York Edison Company, and the cost for insurance rates, we compiled the following table:

Costs to be Considered in the Operation of a Pierce-Arrow Five-ton Truck.

Fixed charges vary and so should be determined by each owner, but the following list includes all the necessary items, some of which may be changed or left out.

The operating charges are accurate and conservative; if truck receives the consideration it deserves they will be much less.

COST OF TRUCK COMPLETE WITH \$300 BODY—\$4,800.

Interest @ 6%	\$288.00
Insurance, Fire @ 2 1/4%	108.00
(\$394) Liability \$5,000 one person, \$10,000 one accident	122.00
Property damage \$1,000	48.80
Collision 2 2/5% (\$25 deductible coverage)	115.20
Garage @ \$25 a month	300.00
Driver @ \$21 a week	1,092.00
Helper @ \$12 a week	624.00

Fixed charges per year	\$2,698.00
Fixed charges per day (1/300 year)	9.00

	Per Mile.
Tires (8,000 miles guaranteed for \$480)	\$0.0611
Gasoline (4 1/2 miles per gal. @ 17c.)	0.0377
Lubrication: (Motor 250 miles per gal. @ 60c.), (transmission, 5,000 M.P.G. @ 65c.), (rear axle, 5,000 miles to 3 1/4 gal. @ 65c.)	\$0.0030
Repairs and overhaul (maintained and overhauled every 15,000 miles for \$375)	0.0250
Depreciation (truck good for at least 150,000 miles and deducting cost of tires)	0.0287
Operating cost per mile	\$0.1555

To find the cost for doing any work, add the fixed charges to the product obtained by multiplying the miles run per day, by the cost per mile.

From this table you will see that it cost 68 1/2 cents per mile to run a five-ton electric truck 24 miles a day, and from the second table giving the cost for operating a five-ton Pierce-Arrow truck, you will find that it costs 53 1/2 cents per mile with our machine to run the same distance.

Cost of Operating a Five-ton Electric Truck

based on investigations made by the Electrical Engineering Department of the Massachusetts Institute of Technology. Several five-ton electric trucks were carefully watched by them over a year, and results recorded in their report dated October, 1912. The insurance and current prices are New York city rates.

COST OF TRUCK COMPLETE WITH \$300 BODY—\$4,000.

Interest @ 6%	\$240.00
Depreciation @ 10%	400.00
Insurance (all four kinds)	371.00
Garage @ \$20 a month	240.00
Driver @ \$18 a week	936.00
Helper @ \$12 a week	624.00
Sundries	260.00

Fixed charges per year	\$3,071.00
Fixed charges per day (1/300 year)	10.23

	Per Mile.
Tires	\$0.978
Current @ 4c. K. W. H. 40 K.W.H. necessary for one charge for 30 miles	0.0533
Battery renewals	0.0528
Repairs, overhaul and painting	0.0378
Lubrication	0.013

Operating cost per mile	\$0.2547
-------------------------------	----------

There is a great scarcity of data available for others than those in the electric vehicle manufacturing business, showing what it costs to operate such machines, as it is generally assumed that the electric truck costs much less than does the gasoline truck. The electric vehicle manufacturers seem to be willing to let the matter stand as it now is, and we are doing our best to get the true figures, so more accurate comparisons can be made.

ROBERT C. REID,
Harrolds Motor Car Company.

"Comparing the Incomparable"

To the Editor of the **SCIENTIFIC AMERICAN**:
I have been interested deeply in the articles upon motor trucking which ap-

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Here is a tale told by Goodyear tires to 250,000 users.

Told nearly two million times.

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This Tale

Rim-Cutting is simply impossible with a No-Rim-Cut tire.

With old-type tires, rim-cutting ruins about 23 per cent.

No-Rim-Cut tires—our patent type—are 10 per cent over the rated size. And that, on the average, adds 25 per cent to the tire mileage.

These two features together save motor car owners a million dollars monthly.

The Goodyear Non-Skid is a double-thick tread, made of very tough rubber.

It is so thick that the blocks are cut very deep. So tough that the blocks are immensely enduring.

They grasp the road surface with a bull-dog grip.

And these projections aren't separate. They meet at the base, so the strains are distributed the same as with smooth-tread tires.

So this is by far the most efficient, the longest-lived non-skid.

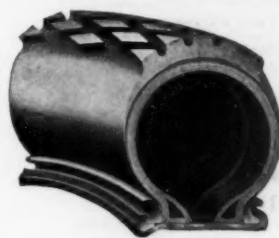
Listen To It

Now let these tires tell their tale to you—tell it by mileage figures—tell it by lower tire bills.

They will tell it in a way which you can't dispute. And it will, in the long run, save you hundreds of dollars.

The evidence is—A quarter-million men who heard this tale have come to Goodyear tires.

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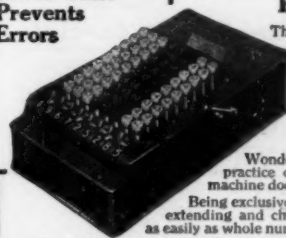
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Rumely Bulletin No. 12

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appears in your issue of January 18th last. The pictures given on the front cover and on page 70 of this issue to accompany the articles by Messrs. Perry and Ritchie bring out in unique manner some of the comparative properties of motor trucks and horse-drawn wagons. But I do not believe the two comparisons are as discrepant as suggested in your editorial entitled "Comparing the Incomparable," and I desire to take this opportunity of pointing out wherein the view points of the articles differ.

The article by Mr. Perry considers only the "possible" work by gasoline motors and by horse wagons. The daily mileage cited for horse wagons (16 to 20) is approximately what they are to-day traveling in city services; the mileage of 40 to 60 per day as mentioned for motor trucks is being covered by those motors which are in comparatively long haul services, but is impossible by even high-speed cars in a great portion of urban work. The services in which motors cover more than say 30 miles per day are admittedly too severe for horses, and most of them were not performed by road vehicles before the advent of the automobile. A comparison of the cost of moving a ton over a mile under the two sets of circumstances is not logical, any more than it is logical to claim a superiority for the railroad which hauls between Chicago and New York at a lower ton-mile operating cost than the road which hauls between New Haven and New York.

Instead of stating the possible performance of motor and horse wagons in entirely different services, it would seem desirable to consider their relative performances when used in the same service and under the same conditions. This was the basis of the data reported in Mr. Ritchie's article. As stated in the text, particular services were selected for each size of wagon and the territory covered in each case was assumed to be within four miles of the loading points. The results of comparing the horse, electric and gasoline wagons show that in this limited area the horse wagon is by no means out-classed, particularly in the lighter capacities.

The reason for this deduction, which is referred to in your editorial as "startling," is not hard to find. It is the amount of standing time required by our present delivery methods, as horses are seldom moving more than 40 per cent of the working day. The chief superiority of the motor truck over the horse wagon is the higher speed, which is from two to three times that of the horse. Thus, when the time taken in loading and discharging restricts the moving time of a motor to between 2 and 3½ hours per day, the motor cannot travel any 60-mile distances. Particularly in retail deliveries it is difficult to reduce the standing time of a vehicle beyond certain limits as a large portion of this item is dependent upon the customer's convenience.

Comparing motors and horses in this way is undoubtedly, as you suggest, "like comparing a marathon runner with sprinters over a hundred yard dash." But because the marathoner was defeated in such a match, who would claim that he was not well developed physically? Both he and the sprinter have their recognized places on the lists of a meet.

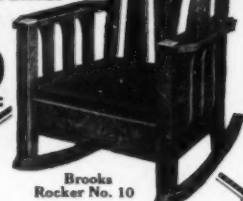
Just so with the horse, electric and gasoline wagons. A comparison of the three types of vehicles in a given service and under the same operating conditions shows one of the three to be superior. In another service one of the other types might be superior; analysis only can tell. For the services cited in the report of the study by the Massachusetts Institute of Technology the electric truck was found to have advantages in point of cost. The Institute's study is intended to supply information by which the cost of performing a given service with each of the three types of vehicles can be compared. It is manifestly impossible to cover all classes of service in a single comparison.

Very respectfully yours,

H. F. THOMPSON, Research Associate,
Massachusetts Institute of Technology.

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Painting the Wonders Under the Sea

(Concluded from page 178.)

resemble nothing so much as huge butterflies on the wing. Exquisite little fish, noted for their curiosity of this strange creature in their world, and also for their almost unbelievably perfect and brilliant markings, crowd around him and swim between his fingers. The parrot fish are more dangerous, for their beaks, like those of our parrots, are sharp and strong, and if the fish is one of the larger species it can easily take a nip out of one's hand.

Under the water, says Mr. Pritchard, one seems to see rivers, lakes and waterfalls just as one does above the water. The gleaming sand, swept down by the action of the tides, furnishes this illusion. One of Mr. Pritchard's paintings of coral rocks gives the impression of a raging torrent, forcing its way between cliffs and dashing its spray up the sides of the rocks.

From sharks, octopi and swordfish there is, of course, danger. But Mr. Pritchard takes care never to descend in a spot where there is a notable absence of small fish, for that is a sure sign of danger. The most beautiful and bewildering sight of all, says the artist, is a school of fish darting by in a maze of reflected light, making the water quiver and scintillate and thrilling the silent watcher.

Mr. Pritchard's finest work has been done at Tahiti, but he has secured excellent subjects off Santa Barbara. According to the artist, the coloring beneath the ocean is all in the lowest keys, merging from deep indigo and purple into the lighter, delicate tints of pale greens, grays and yellows. Every point, every sharp edge, shimmers like silver in the upper regions. Rocks and cliffs in the dim light assume an appearance of inconceivable size. On land we see the foundations of every object, no matter how large or small its bulk, but when one looks down into the depths of the huge coral formations under water they seem to be resting upon deep, blue air.

Although he can work at any reasonable depth, Mr. Pritchard prefers about thirty feet, for there the light is clearer and at its best. He can remain under water, when wearing a diving helmet, over half an hour with perfect comfort.

Recent Improvements in Machine Tools

(Concluded from page 180.)

handles 11 permit the operator to slide the gears 5 into and out of mesh with the pinion 4 to start or stop.

Each shaft 6 has two cranks, 12 and 21; the former, which operates the cutter, comprising a bolt 14 slidable in a T slot 13 in the shaft 6, positioned by the screw 15 and held by the sleeve 17, nut 16 and washer 18; the latter, controlling the feed, consisting of the bolt 22 and sleeve crank-pin 23 working in the slot 25 of the connecting rod 24. A screw 26 and block 27 limit the movement of the pin 23.

The connecting rod 20 connects the crank 12 with the cutter spindle 31, revolvably mounted in the knuckle 32, which is hinged to the adjusting turnbuckle 29 by the pin 33. The connecting rod 24 is adjustable as shown, and connects the crank 21 with the feed connections. These consist of the bar 85, mounted to slide in the guide 86, and connected to the arm 87 of a bell-crank, the arm 88 of which is connected by the rod 57 to the feed plate 56.

The cranks 12 and 21 are shown opposite for the sake of clearness, but are actually at an angle to each other.

The feeding mechanism is as follows: Projecting from the frame are the heads 37 with caps 38, in each of which is revolvably mounted the outer eccentric sleeve 39, having a fixed gear collar 40. The last meshes with the idler gear 36 on the stud 63, and this meshes with the pinion 42 on the spool 43, mounted on the fixed shaft 41. A pinion 44 on the upper end of the spool 43 meshes with the gear 45 at the lower end of a sleeve 46, which is also revolvably in bearings 47 on the head 37.



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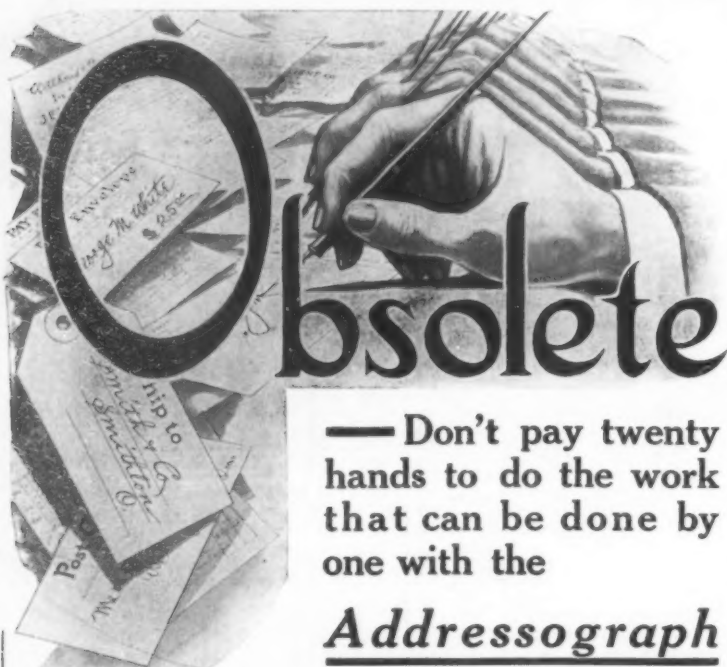
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The lower end of the driving sleeve 48 is revolvably supported in a depression in the upper end of the inner eccentric bushing 50, and is slidably connected to the spindle by the feather 49. At the upper end of the inner bushing is a ring 53 with oppositely extending ratchet teeth 54 and 55, which ring is secured to the flange 52. The feed plate 56, mounted just above the ring 53, has a pivoted block 58 connected to and reciprocated by the rod 57 and the crank 21, the stroke of this plate being determined by the screw 26. A plate 60, secured to the sleeve 48 by a screw 59, rides on the sleeve 46 and has a slot 61 containing the bolt 62, which engages the sleeve 46.

When the outer bushing 39 is turned, the gear 40 will turn the spool 43, and the sleeve 46 through the idler gear 36. The plate 60 thus acts as a crank of which the bolt 62 is the crank-pin, so that the spindle will revolve at the same speed as the sleeve 46.

The operation of cutting a square hole is shown in Figs. 5, 6, and 7. A round hole is first drilled to admit the cutter 30 (Fig. 5), which reciprocates up and down while being swung out to the position shown in Fig. 6. The spindle 31 is then carried around a path 35 while it is turned in the opposite direction on its own axis, so that at the end of a proper number of strokes, depending on the feed, the position shown in Fig. 7 is reached.

As will be seen, the movement of the spindle is three-fold. First, a lateral movement to get the required eccentricity—to carry its center to the path 35; second, a movement in the path 35; and third, a reverse rotation on its own axis equal to the number of sides of the hole, divided by the number of sides of the cutter, times a full revolution. The last is caused by the turning of the outer bushing 39, and by means of the gears 40, 36, 42, 44, and 45, the collars 46 and 48 and the plate 60. The second movement is also caused by the turning of the outer bushing 39. The first movement is caused by the turning of the inner bushing within the outer, and is accomplished as follows:

A pin 64, carrying the spring-held pawls 65 and 66, is mounted on the feed plate 56. The upper pawl engages the teeth 54 of the ring 53 so that as the plate reciprocates the inner bushing 50 will be turned. A stop 67 is secured to the ring 53, and a second stop 68 is mounted on the upper end of the outer bushing 39. When these two stops are in engagement, the spindle and outer bushing 39 will be concentric, the eccentricities of the two bushings being the same. Turning the inner bushing within the outer will carry the spindle outward. On the outer bushing is secured a worm gear 70, and around this worm gear is revolvably the ring 71, which has lugs 72 carrying the shaft 73, to which is secured the worm 74, which meshes with the worm gear. The ring 71 carries a stop 75, which is in the path of the stop 67. Turning the shaft 73 of the worm 74 will position the stop 75 with reference to the stop 67, and thus limit the movement of the inner bushing within the outer. As the feed plate reciprocates, the ring 53 and the inner bushing will turn, carrying the spindle outward until the stop 67 engages the stop 75 on the ring 71. As the ring 71 is locked to the outer bushing through the worm 74 and worm gear 70, any further turning of the inner bushing will cause the outer bushing to turn. This results in first carrying the cutter from the position shown in Fig. 5 to that in Fig. 6, and next, because of the common movement of both bushings, from the position in Fig. 6 to that in Fig. 7. At the same time, because of the gears 40, 36, 42, 44 and 45, the cutter turns back on its own axis one and one third of a revolution at each full revolution of the outer bushing.

To return the parts, the pawl 65 is disengaged when the eccentric bushing 50 can be readily turned back by hand until its stop 67 engages the stop 68 on the inner bushing.

The table 102 is constructed as shown so that the machine may be employed also as an ordinary slotting machine.

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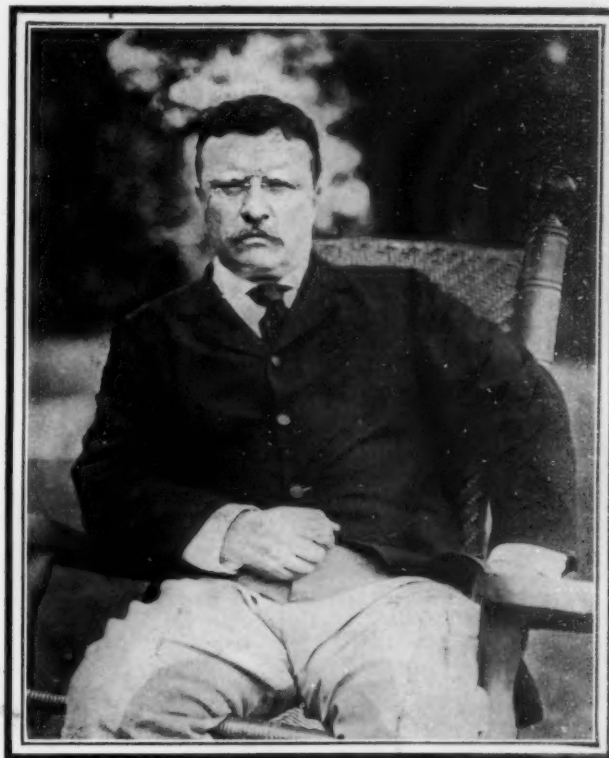
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(12749) W. D. A. writes: I take the liberty to make a correction in the answer to query No. 12733, occurring in the issue of the SCIENTIFIC AMERICAN of January 25th, in which F. R. asks why razors and other steel tools seem to lose their edge, and when laid aside without sharpening seem to regain their original keenness. The theory regarding this is that the fine, thin edge of steel forming the cutting edge of the tool is bent over in service and the tool becomes dull. When we hone or strop this edge we bend it back into its original position and the tool is sharp once more. If the tool is laid aside without honing or stropping, this thin edge will gradually bend back of itself and the tool will be sharp again. This is the phenomenon to which F. R. refers, and is known as the "elastic lag" of steel. It takes time, however, and is visible only under a fairly powerful microscope. A. We thank you for your suggestion of a different theory from the one we advanced regarding the belief that a razor can recover its edge by laying it away to rest. We have never met with any facts to show that a piece of steel, or other metal in fact, can bend itself back into shape after it has been bent, beyond its limit of elasticity. A razor edge, or the edge of any other tool, when turned over has been thus bent. "Elastic fatigue," as it is usually designated, does affect the time of recovery of a spring when not bent beyond its limit of elasticity. But when this limit has been exceeded, no force exists in a piece of metal to move it back again into its former shape. We have never seen any references in scientific literature to support the theory which you advance, and should be very thankful if you will give us the references to the authorities on this point upon which you base your statement. We have many times examined the edges of razors under the microscope, but never saw the recovery of the edge. We are open to conviction, and shall be glad to receive the references in question.

(12750) F. E. V. asks: Will you kindly answer the following: If a large tree, located hundreds of miles from any living creature, should be struck by lightning, crash to the ground, crushing many smaller trees in its downward path, would it make any noise? The writer contends that although the sound waves would be set in motion, there would be no sound unless they came in contact with an ear drum. Is that correct? A. Your query simply requires a definition of the word "sound." The dictionary gives two definitions. One is a sensation; the other is the physical definition, which is used in all textbooks of physics, and which is "Such a rate of vibration as can affect the auditory nerve." Sound, the sensation, cannot be produced excepting there is an auditory nerve to receive it and transmit it to the brain. Sound, the external cause of the sensation, exists whether there is an auditory nerve in the vicinity or not. Take your choice. Both definitions are correct. There need be no controversy. Most controversies would be soon settled if the parties determined the exact meaning of the terms employed in their discussions.

(12751) R. W. asks: A funnel-shaped vessel, 12 inches long, 12 inches in diameter at the top and tapering to 3/4 inch at the bottom, is filled with water, the top of the funnel being left open to the atmosphere. The small end of the funnel is connected to a larger vessel, in which the air has been extracted. At what pressure would the water be discharged in the vacuum? A. The case you send us is answered as follows: The water will be discharged into the vacuum below with a pressure equal to the pressure of the atmosphere at the moment plus the weight of a column of water 3/4 inch in diameter and 12 inches high. The shape of the funnel does not affect the result. Only the cylinder of water from the opening below to the top of the water is concerned in producing the pressure. The principle is demonstrated in mechanics by what are called Pascal's Vases, which are dishes of various shapes, but all have the same sized bottom outlet and the same height or depth of water. It is shown that the pressure in all at the bottom is the same. You will find these illustrated in almost any high school textbook of physics in your city library.

(12752) C. S. asks: B claims it is much easier for a person to swim in salt water, meaning the ocean, than in fresh water. I claim the difference is too small to be noticed by the swimmer. Will you please enlighten us on this subject? A. It is much easier to float in salt water than in fresh water. Hence it may be said to be easier to swim in salt water; but a person must push his weight of water out of the way every time he moves his length in either case, and thus the work done in swimming is the same in both salt water and fresh. Work is equal to the resistance times the distance the resistance is moved. In this case the resistance is the weight of water which is pushed out of the way by the swimmer. Water equal to one half of the weight of the swimmer is pushed aside to a distance equal to one half the width of the swimmer on each side of the swimmer. This gives the work done in swimming each time the swimmer moves his length.



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